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[ILLUSTRATED.]

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Transformers in Use at Antwerp.

Some interesting experiments in electric lighting with transformers were carried out on the 18th by the Societe Industrielle d'Electricite, of Brussels, in the presence of a large number of notabilities. The guests were received by M. Beckmann, member of the Chamber of Representatives, and M. Dewalque, professor at the Louvain University, both of them "administrators" (directors) of the company, and M. Goffin, chief engineer, conducted the trials. These were in connection with a new central station to be established at Berchem-lez-Anvers, with transformers used under special and unusual conditions. This is the essential point of the system which is already working experimentally, but with success, in the shops of the Industrielle. The transformer adopted by this company maintains 500 lamps 5 kilometers (3 miles) off with a four-millimeter wire. At Berchem the engines will be placed at a distance of 2½ kilometers (1½ miles) from the transformers. The main current of 1,000 volts is conducted from the dynamo to the exit poles of the *ensemble* of apparatus composing the system, passing through an ampere meter on one side, and on the other through an induction coil *C* (see diagram of

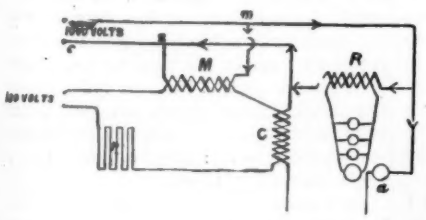


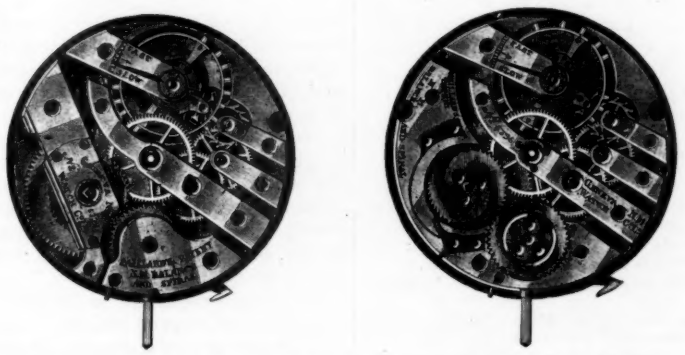
DIAGRAM OF ANTWERP INSTALLATION.

installation at works), formed by a double winding round an iron core. Immediately after leaving the poles of the dynamo the main current is shunted at *m n* to a transformer *M*, which the inventors call a magnetizer, because it serves to produce a secondary current for exciting the machine. This current, issuing from the magnetizer, goes to the poles of the machine, entering the coil *C* at both ends, thus forming a compensator. This double arrangement on the outside constitutes a hyper-compounding of the arrangement, and it is thus that so perfect an accordance is obtained of expenditure of current with the number of lamps in use. The exciting current also passes through an artificial resistance *r*, variable by hand, which serves to regulate the initial intensity of the excitation, and to bring the machine to its normal *regime*. *R* is a small transformer, also in shunt circuit, which constitutes the reducer, the office of which is to reduce the tension of the current, so that it may be measured by the ordinary appliances. It also affords the means of maintaining the lamps at the central station, which are in a secondary circuit. The other poles have shunt circuits to the three transformers at the end of the distance to be traversed, viz., at Berchem. Be it added that, by a similar arrangement, another commune or district, near Antwerp, may be electrically lighted for 2¼ centimes per lamp per hour, while gas costs 3½ centimes per burner per hour.

Use of the Siemens Torsion Galvanometer for the Direct Measurement of Strong Currents.

In order to obviate the use of a shunt, which introduces errors owing to the alteration of its resistance due to the heating effect of the current, the author uses a torsion galvanometer set up on a board, on which is fixed an independent coil of thick wire on each side of the galvanometer. By this means it is possible to measure currents up to 70 amperes; when the measurement of the current is being made, the extra coils alone are used, the fine wire coils of the galvanometer itself being out of circuit. The additional coils must be placed with care so that the poles of the thimble magnet are exactly on the axis of the coils, and exactly in the center between them. To effect this, one of the coils is provided with a screw adjustment. The modified instrument is calibrated by comparison with a

FIGS. 1 AND 2.—FRONT AND SIDE VIEW OF PAILLARD'S NON-MAGNETIC COMPENSATING BALANCE.



FIGS. 3 AND 4.—SPECIAL WATCH MOVEMENTS, CONTAINING NON-MAGNETIC BALANCE.

standard, the coils being first connected in series so as to have a double action on the magnet, and then the connections of one reversed so as to have no action. By a simple arrangement of mercury cups and copper bridge-pieces it is easy to change the connections from the coils of the galvanometer proper to the additional coils, so that either the current or the difference of potential may be measured on the same instrument.

Non-Magnetic Time-Pieces.

It will be remembered that there appeared in the REVIEW several weeks ago a description of the new watch movement of the Geneva Non-Magnetic Watch Co., of this city. We present on this page detailed illustrations of two movements of these watches, as well as the palladium compensating balance invented by C. A. Paillard, of Geneva. This invention, controlled by the above watch company, is the one mentioned in Lieut. Toppan's admirable paper before the Electric Club recently, and is of particular value to workers in electrical establishments, and, in fact, to all users of time-pieces.

Hermetically Sealed Batteries.

The cell is made of ebonite, and is closed by an ebonite lid with a washer of soft india-rubber. The upper part of the cell is split up into several divisions in which are placed the carbons and zincs; the lower part contains the exciting fluid. The battery is put into action by reversing it. In the ebonite lid are apertures closed by thin sheets of india-rubber. These allow of the expansion of the gas produced in the battery, without any risk of damage to the ebonite cell, and without the acid being forced up through the vent, as is the case in other hermetically sealed batteries.

The Term Incandescence.

The term incandescence, so much used at present, indicates a white heat, or the glowing whiteness of a body caused by intense heat. The little glass bulbs, remarks a writer on this subject, with their brilliant horseshoe of glowing filament, attract no more attention than the flickering gas jet. But the facts about the gas jet are, unlike those of the electric lamp, easily and generally understood. Both produce light by incandescence, the molecules of gas being rendered incandescent by the heat generated by the combustion of other molecules. The blue portion of every gas flame is where combustion is taking place, and from there comes the heat which keeps the rest in a state of incandescence. With the electric lamp, it is the heat produced by the friction of an electric current compelled to go through a fine carbon filament, which raises that filament to a condition of incandescence, which produces light.

Simplifying the Telephone.

Guibollard is explaining the telephone to his wife:

"Do you know, Zenobia, how this ingenious instrument is worked?"

"No, my dear."

"Well, you seize the apparatus with one hand and then you—speak with the other."
—From the French.

MAGNETISM IN WATCHES AND CHRONOMETERS DISCUSSED BY THE ELECTRIC CLUB.

LIEUT. F. W. TOPPAN, U. S. N., PRESENTS A PAPER OF GREAT INTEREST—CHANGES IN THE BY-LAWS OF THE CLUB.

With the elements arrayed against them, the enthusiastic members of the Electric Club to the number of sixty odd, did not hesitate to attend the regular monthly meeting at the Hotel Brighton, last Thursday night, July 21st. They were brought together by the promise of a paper from that able young naval officer, Lieut. F. W. Toppan, now connected with the Edison Company; and the intentness with which the interesting statements were listened to, and afterwards earnestly discussed, showed the interest the topic as presented awakened in the minds of those present. At the dinner, which was well served and most excellent, President H. C. Davis occupied the head of the table, flanked on either side by Mr. Frank Ridlon, president of the Boston Electric Club, C. J. H. Woodbury, also of Boston, and by the speaker of the evening, and Col. J. N. Keller.

Among others present were: Hon. John Rooney, M. W. Goodyear, Charles Dutton, C. O. Baker, jr., Col. Henry Harney, Geo. Manson, H. A. Reid, Geo. Porter (of Philadelphia), P. C. Ackerman, A.O. Kittridge, H. D. Hall, J. C. Chamberlain, J. W. Howell, Dr. H. A. Bunker, George Worthington, James Beesley, W. B. Vansize, A. C. Smith, Addison Conkling, John A. Seeley, J. H. Blasdell, Felix Gottschalk, A. J. Dam, L. N. Downs, H. B. Lytle, Walter C. Kerr, E. F. Peck, Mr. Davis, Messrs. John Noonan, Judge Hopper and Ex. Postmaster Conkling, of Paterson, Gen. C. H. Barney, A. F. Stanley, T. L. Fowler, Thos. T. McTighe, Frank G. Stone, M. Roosevelt Schuyler, H. L. Bancroft, Lieut. Andrews. U. S. A.

Dinner ending, the following resolution was presented by Chairman Baker, of the special committee, and adopted:

WHEREAS, The Electric Club has lost its first member in the death of Mr. Jackson Bailey, a gentleman of ability, integrity, and true manhood, therefore

Be it Resolved, That as a token of our high regard for our deceased associate, we have this resolution recorded on the minutes of the Club, and a copy sent to the bereaved family.

The fee for life membership in the club was raised from $200 to $500, and the annual dues of resident members raised from $15 per year to $30, the initiation fee to be $20. Non-resident members will pay dues of $20 per annum. These changes will affect present members from November 1st (the end of the fiscal half year) and all new members from date. It was also voted that officers of the army and navy could become non-resident members for life upon payment of an initiation fee of $75. Mr. Baker gave notice of amendment that he would bring up at the next meeting, and then Lieut. Toppan read his paper, Mr. M. W. Goodyear having been called to the chair and presiding through the rest of the meeting.

RECENT SCIENTIFIC DISCOVERIES RELATING TO THE EFFECTS OF MAGNETISM ON MARINE CHRONOMETERS AND WATCHES.

Mr. President and Gent'emen:

It will, perhaps, be of interest to many of you if I preface my remarks with a brief

sketch of some of the historical points which led up to the finished watch and chronometer of to-day.

A time-piece for the determination of a ship's longitude was unknown at the beginning of the eighteenth century; ships went to sea with the most primitive means for laying their course to distant ports, sailing by day and furling their sails by night, lest they might strike some unknown shore. Sea voyages were long, tedious and extremely perilous. In consequence, the maritime nations, and England especially, keenly felt the want of an instrument or time-piece for the determination of the longitude at sea. In the year 1714, during the reign of Queen Anne, the English Parliament passed an act constituting a Board of Longitude, with certain powers. This board found it expedient to offer three prizes of £10,000, £15,000, and £20,000 for the production of a good time-keeper, which would be the means of enabling mariners to find the longitude at sea within 60, 40, and 30 miles respectively. For 14 years the offer remained fruitless, when one John Harrison, a self-made man from Yorkshire, presented himself, with the offer to solve the problem; he had experimented on pendulums and invented the gridiron compensation

His experiments on the effects of temperature on various metals suggested to him the principle of compensation to watches, in order to counterbalance the variation in rate by the expansion and contraction of the balance spring in heat and cold.

Harrison's compensation was effected by a laminated piece fixed to the plate at one end, and at the other a carrying curb or regulator pins, between which the spring acted, and it was by the movement of these pins, to and from the stud, into which the terminal end of the spring was pinned, lengthening or shortening the acting portion of the spring, that the watch was regulated; this curb acting in the same manner as a watch regulator is moved by hand.

But, notwithstanding Harrison's suggestion that the compensation should be affected by the balance, the honor of constructing the first compensation balance is acknowledged to belong to Julien Le Roy, the famous French watchmaker.

Harrison, having satisfied himself of the satisfactory performance of his time-piece, by trials on board a barge, proceeded in one of the Government vessels to Lisbon. On this voyage he was able to correct the reckoning to within one degree and thirty minutes, and the Board of Longitude granted him five hundred pounds, to enable him to improve his time-keeper.

After laborious exertions he was enabled to ascertain the longitude to within ten miles, or twenty miles less than the distance required by the Board of Longitude—but he did not obtain the full amount of the prize, set upon his accomplishment, till the year 1757, nine years before his death. Harrison was a man of extraordinary genius and perseverance, as he had a great many disappointments to encounter, and the present perfection of the ship's chronometer is greatly due to his exertions.

From this time forward to the present day unremitting exertions have been made to perfect the chronometer; both the English and French Governments having encouraged, by rewards, the improvement of the instrument. For a number of years the English Government has paid premiums of three, two and one hundred pounds yearly for the three best chronometers sent to Greenwich for competitive trial, knowing that there remained serious defects to be eliminated. But, as it was finally demonstrated that these premiums bore no fruit, they were withdrawn, and a government purchase is the only stimulus given to individual effort, beside the privilege, that the fortunate vender may assume the title of "Makers to the Admiralty."

The defects still existing in our time-pieces of precision appertain mainly to the adjustment for temperature and to such errors as are produced by the tendency of the metals, used in construction of certain important parts, to influences which cannot be controlled. Harrison found that the adjustments for changes of temperature ought not to be made by a device acting on that part of the machine which was the principal cause of the error, namely, the balance spring, as such adjustments totally destroyed its isochronous properties, which were already unavoidably impaired by the balance spring losing its elasticity in changes of temperature. This adjustment had to be made on the balance, by causing its laminæ, free at one end, to move to and from the center. By this means the momentum of the balance was changed in a direction, to counteract the evil effects of the change of temperature on the length and elasticity of the spring balance pin. But all corrections attained have failed to accomplish all that was needed.

Astronomers, scientists and men of the greatest mechanical genius have grappled with the problem and report no progress, except the conclusion reached, that the employment of steel and brass in the manufacture of the spring is not desirable, moreover, failing as it does to meet the causes of disturbances, which cannot be controlled.

One of the most prominent of these uncontrollable causes of disturbances is magnetism. Until within a few years the only errors sought to be eliminated were those principally due to the changes of temperature. But a new problem has now presented itself, and that is, to meet the evil effects of magnetism

The earliest scientific records notice the operations of a subtle natural agency, peculiar in many respects to bodies containing iron, and acting more especially on iron and steel. By this agency ferruginous particles are drawn together and frequently in opposition to the force of gravity.

Notices of such phenomena are found in very ancient manuscripts, especially in those of China, and also in the writings of the Greek and Roman philosophers.

The existence of this subtle agency was first observed as a property of a mineral substance, of a grayish black color. The Greeks obtained it from the province of Magnesia, and termed it "magnes," from whence the term magnet and magnetism, the one designating the mineral substance itself, the other the peculiar agency supposed to reside in it.

In a celebrated philosophical poem by the Roman poet Lucretius, who flourished about 60 B. C., we find the magnet, with illustrations of its power, very beautifully treated.

In the translation of this poem, by Dr. Busby, he thus renders the passage:

"Now, chief of all, the magnet's power I sing,
And from what laws the attractive functions spring;
The magnet's name the observing Grecians drew
From the magnetic region where it grew;
Its viewless potent virtues men surprise,
Its strange effects they view with wondering eyes,
When, without aid of hinges, links or springs,
A pendent chain we hold of steely rings
Drop from stone—the stone the binding source—
Ring cleaves to ring, and owns magnetic force:
Those held superior, those below mountain,
Circle 'neath circle downward draws in vain,
Whilst free in air disports the oscillating chain."

The earth is a great magnet, and currents of electricity are induced in all conductive material in which motion takes place at its surface. Consequently every piece of metal capable of polarity must be "magnetized" or in a magnetic state.

There are secular, periodical and irregular changes, to which the earth's magnetic force is subjected. Secular changes are such as are slowly progressive, and which run through a certain course in a very long period of time, returning finally to their original value. Periodical changes are certain regular changes or variations, happening in short periods of time, such as a day, a month, or even a year. Irregular changes are such as cannot be traced through any uniform course, and which are apparently not subject to any given law.

Magnetic storms come under the head of this latter class of perturbations, and it is to the illustrious Humboldt that we owe all our first knowledge of these facts. Being engaged at Berlin, in 1806 and 1807, in examining the changes in the declination of the compass needle for every half hour, his attention was called to certain capricious agitations in its position, not referable to any accidental or mechanical cause, and which occasionally caused so great an oscillation as to lead him to refer it to a sort of magnetic reaction, propagated from the interior of the earth. He accordingly designated those disturbances as 'magnetic storms," as being analogous to the sudden changes of electric tension, which ensue in the electric storms of the atmosphere.

Magnetism meets us at every step, because steel and iron have entered largely into the processes of construction and manufacture. Ships built of iron must not only be strongly magnetic, because of the vast quantities of this metal, which is subjected to the action of terrestrial induction, but that by reason of the hammering of hundreds of thousands of rivets as well as from the bending of plates and bars, during the progress of construction, there must be an extremely high development of permanent magnetism. Each iron ship must have a special individuality of the magnetic distribution, depending essentially on the position of the keel and head, whilst building, such distribution having in each individual case a polar axis and equatorial plane conformable to those of the earth at the place where the ship is built. An iron ship may be looked upon as in itself a large permanent magnet.

Changes of condition of polarity are continually going on in all moving metals—the iron in a ship as well. Every time the ship pitches or rolls the polarity changes, and has an influence on the compass needle and on the chronometer. Every time the direction of the ship is changed its magnetic condition is changed, and will have a consequent influence on the metal.

Magnetism is a condition, and it is the natural condition of the molecular atoms composing iron and steel. This condition may be made more or less "intense" by causes; the balance wheel of the chronometer is "polarized" and is a good compass needle in itself, as you will see by floating it on water, and is as sensitive to polar conditions and surroundings as the compass needle; although it does not show it to the eye, because the main spring is driving it through these lines of polarity so rapidly; but it will show the result in its "rating." These variations in rating will show in every degree, from the fraction of a second up to the point of stopping, according to the strength of the magnetic force applied. The force of the influence exerted on a chronometer is exactly the same as on the compass needle. The same polarity which causes the needle to lurch one way or the other will have a corresponding effect on the chronometer balance, and a consequent change in "rate," or irregular time.

The practical application of electricity has made giant strides, and electricity applied mechanically means magnetism in some form. The appliances for generating electric light and motive power are pregnant with magnetism, contaminating the whole atmosphere surrounding dynamos, motors and wires.

The chances of injury to chronometers and to watches especially, by magnetism, have been greatly multiplied by the development of the dynamo and its extensive application to electric lighting and other purposes; so it is very common to find magnetized watches in the hands of persons having no connection whatever with electrical appliances. A watch readily becomes sufficiently magnetized to derange its action and render it entirely unreliable. If the regulating part of a chronometer or watch—that is to say, a balance, together with the hair spring—should be badly affected by magnetism, which happens very often, it is clear that the time-piece will suffer more or less, according to the fineness of construction and delicacy of adjustment.

All these changes herein referred to have their influence upon magnetic metals, and, as I have before stated, those metals entering largely into the construction of the balances and balance springs of chronometers and watches, can we wonder why our time-pieces are found inaccurate and unreliable?

The greatest cause of error, as may be inferred by the foregoing, is our present compensation balance and our steel balance spring.

Little did John Harrison imagine, when trying to provide a corrective for the expansion and contraction of the balance and balance spring in changes of temperature, that, as shown by Berthoud, the changes in the elasticity of the balance spring were the real evil, and the expansion of the metal was really an insignificant factor compared to the former, as the combined expansion or contraction of the balance and balance spring is about one-fifth in effect, demanding compensation, while the changes in the elasticity of the balance spring demand the other four-fifths of the compensation needed.

The invention of the compensation balance is rather the result of inventive genius and practical experiment than a contrivance based on well-defined mathematical and scientific principles. But without entering further into this part of the subject, it can be stated as a fact that having a steel compensation balance and hardened steel balance spring, and our present annular compensation balance, the laminæ of which are made of steel and brass, we can obtain compensation for changes of temperature approximating accuracy for a change of 30 degrees Fahrenheit only, unless the auxiliary compensation device is used, when we can obtain compensation for a wider range of temperature.

Makers of compensation balances are very particular about the quality of brass they employ for melting on the steel rims of their balances. Unsound balances frequently result from the quality of the brass; but it is not an uncommon occurrence that even in the best balances the laminæ separate, when exposed for a long time to a very low temperature. Chronometers used in whaling ships stationed for a year or more at Behring Straits often meet with such a mishap. A sliding of the brass on the steel may be the cause. The unequal progression of the ratio of the two metals is a source of error, for steel has a decreasing ratio of expansion in heat, and brass has an increasing ratio.

Some English chronometer-makers have demonstrated by experiment, without any practical result, however, that the necessity for compensation for temperature can be reduced to nearly one-tenth by employing glass balance springs: but these springs have to be made of great length and require much room, aside from the difficulty of making and applying them; they certainly never could be employed in watches.

In a competitive trial of a number of chronometers at the Bureau of Navigation at the Navy Department, Washington, during the first six months of the year 1886 three chronometers were withdrawn from the trial on account of rust having developed on the balance springs. Now, if rust is liable to show itself so early as that, may I ask how many chronometers at sea are likely to be afflicted with this malady, particularly in the tropics? May I ask how many ships have been out of their reckoning on account of rusty balance springs? For nothing destroys the time-keeping of a chronometer or watch so effectually as the most diminutive speck of rust on the balance spring. The deep-seated conviction of this fact has induced watch manufacturers doing business with tropical countries to fit the better grade of watches with gold balance springs, but the life of the elastic properties of these springs was found to be short, and in observatory trials chronometers fitted with gold springs stood low on the list, and did not compare favorably with those having steel springs.

By the foregoing remarks and by some subsequent references emphasizing the high and growing importance of possessing portable machines for accurate time-keeping, and the difficulty of attaining them, I desire to acquaint the members of the club with what Mr. Paillard, a celebrated adjuster of Geneva, Switzerland, has really accomplished, and to show how far Mr. Paillard's efforts have contributed in eliminating or reducing the errors enumerated; for if he has succeeded, and bulletins from the Government Obser-

vatory at Geneva would indicate that he had, then to him belongs the credit of having made a most decided improvement in our portable time-pieces, and rendering a great service to modern horology.

Various metals have been suggested to take the place of steel, but it seems to have been left to Mr. Paillard, after fourteen years of experiment, to finally succeed in discovering and producing, in an alloy of palladium, a metal which is uninfluenced by magnetism or corrosion, and still retains those properties necessary to obtain the finest adjustments for changes of temperature.

Balances and balance springs made of this alloy are of an expansive property, and a specific gravity slightly in excess of steel, but possessed of the very important qualification that it retains its elasticity in heat in a high degree, as verified in observatory trials in various countries, thus reducing one of the worst errors, inherent to a steel balance and spring, aside from its magnetic and oxydable properties; giving us a material which enables us to get a compensation approximating accuracy for a wider range of temperature.

Palladium is a metal of the platinum group, and was discovered by Woldston in 1803. Its specific gravity is 11.3, that of gold being 19, steel 7.7 and palladium alloy 8.5. It is more fusible than platinum and melts easily before the oxyhydrogen blow-pipe at 2,840° Fahrenheit. In its pure state it is not so ductile as platinum.

In producing his balance Mr. Paillard used two different alloys of palladium having a differential expansive ratio in similarity to that of steel. In so doing he at the same time gave us a superior balance, for the two metals composing the laminæ of his balance are congenial, both being made of a palladium alloy and being fusible under different degrees of heat, having the necessary hardness and other qualifications. Numerous searching tests with balances in connection with the palladium alloy springs have given the most flattering results, and we have in chronometers and watches containing these balances and springs superior timekeepers uninfluenced by the hygrometric condition of the atmosphere or any spasmodical electrical condition of the same, and excelling all previous attainments with the steel and brass balance and steel balance spring.

This question of magnetism and the necessity for protection of chronometers and watches against magnetic influences has called forth inventions of machines and devices for demagnetizing time-pieces that had become affected; also a sort of soft iron shield or armor for enveloping the watch movement, as a defense or preventive against magnetic influences. These are mostly cures after harm has been done. There would be no need of these devices if those parts of the chronometers and watches which control the time-keeping qualities were made of metals absolutely unaffected by magnetism, and yet possessing the other necessary qualifications.

In the face of the certain fact, that electrical appliances shall become wider and wider in their range, and the aggressive tendency of electricity for lighting and as a motive power, both at sea and on shore, we must be prepared to meet its magnetic influence at every step in our industrial occupations. In the discovery of this alloy of palladium, a time-piece has been produced that is strictly non-magnetic and non-oxydable, and possessing those requisite and necessary qualities for fine and accurate adjustments to temperature and isochronism and will take rank among inventions of the highest order in horological science.

Discussion.

Mr. C. J. H. Woodbury, of Boston: Although the paper naturally refers to the greater interests of life and property in navigation as far as magnetism in the balance of a ship's chronometer is a factor in the question, yet it is doubtful whether there is a single watch in the room whose steel portions are not magnetized, attended by all the interferences with the rate which magnetization causes, unless the balance and hair spring is free from steel. The first palladium hair spring which I ever saw was shown to me by Mr. Charles F. Brush at Cleveland, in January, 1882. Of course it was absolutely unaffected by the magnetic fields of the electr cal ap paratus, but possessed physical properties equivalent to those of steel, as it was an excellent time-piece.

One of the morning papers to-day contained a telegram from Chicago stating that the Northwestern railroad were to inaugurate a quarterly inspection of watches carried by their men, and one of the requirements was that the watches should be provided with an anti-magnetic shield. Now, if this be correct it shows that the matter is receiving deserved attention, although the attempt at annulling the effects of magnetism, by either placing a magnetic force larger than the irregular and disturbing magnetic forces, or by applying magnetic forces in opposite directions, must in the nature of things be approximate methods, and inferior to those which carry the portions of watches beyond the pale of magnetic influence by the use of non-magnetic material.

The method of adjusting the compasses of iron ships by placing masses of iron, such as cannon balls, near to the compass, in such positions as may be determined by experiment to act with equal force and in opposite direction to the vessel's component of magnetism, is a similar process.

This invention of Sir William Thomson has been of great value to the interests of commerce by rendering the use of the compass practicable in iron vessels. But this method of adjustment is confessedly approximate, remaining correct after once applied, only so long as the local attraction which the masses of iron counterbalance remain constant.

The steamship Pavonia, while making the port of Boston last March, had sailed for five hundred miles by dead reckoning on account of foul weather, and aproached the shore near to Duxbury, while the captain is reported to have said that the vessel must be somewhat north of Boston. The cause of this error of some 30 miles was due to the change in the component of the ship's magnetism, which may have been produced by the buffeting of the waves, an unusual distribution of the cargo, or by some other cause, making changes in the stresses applied to the vessel.

One of the earliest experiments in magnetism set forth in text-books on physics, shows how a bar of steel can be magnetized by striking it a few sharp blows; while we have a more homely illustration in the fact that steel drills are universally magnetic after being used.

I have with me a realistic example of the effect of electricity upon watches, showing you this watch which I wore when struck by lightning, in the Pacific Mills, at Lawrence, six years ago this week. I had been thoroughly drenched by the shower before reaching the shelter of the mill office, and experienced no personal effects from the shock, which destroyed my watch, beyond a paralysis of the throat, which passed away after a few minutes.

[The watch was passed around the table for examination, and showed on the back two straight black stripes, each about half an inch in width, extending across the back, and joining each other at one end, like a letter V.

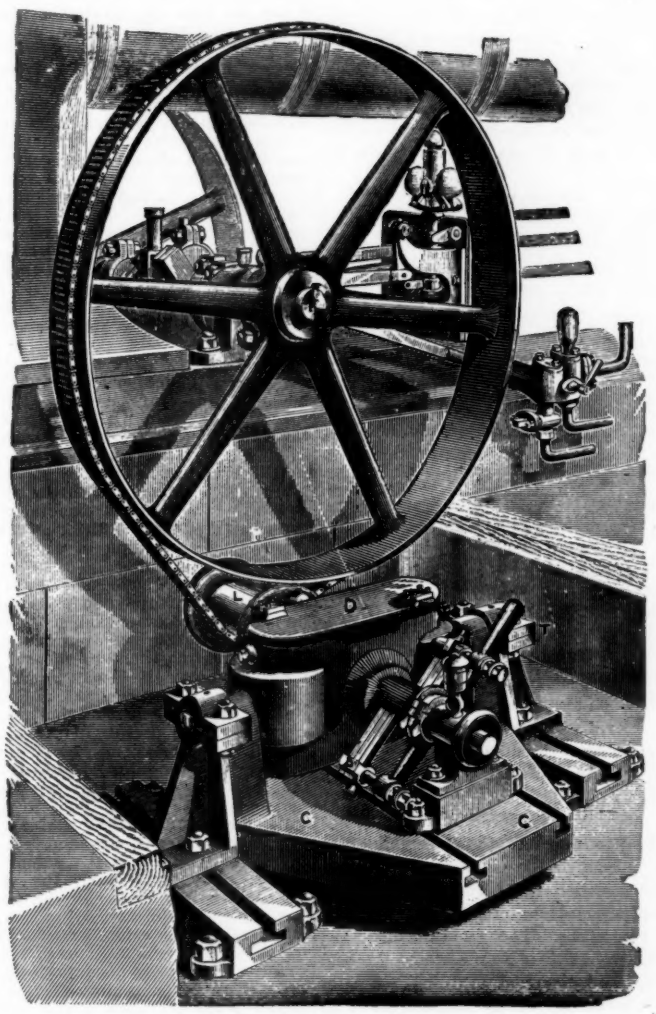
Three of the arbors in the movement were broken by the lightning; but there was no discoloration inside.]

Mr. W. C. Kerr said he had gained some interesting information by being present. A few years ago he had a watch sent him from Switzerland. It was not affected by electricity, had been worn among dynamos and electric generators generally, and it always kept perfect time; and the conclusion he had come to was that there was not this general danger in electricity to time-pieces that was imagined. This evening he had discovered that the reason his watch had not been affected was because it was one containing the non-magnetic parts mentioned in the paper of the evening—was, in fact, one of the early watches in which Mr. Paillard's invention had been used. This was a surprise to him, and he was pleased to now be informed why his watch had always been such a satisfactory time-piece when others so often failed.

Lieut. Toppan stated, in response to Mr. Woodbury's remarks about the Pavonia, that between Patchogue and extending up the Atlantic coast towards Rockaway there was an outlying ledge of rocks consisting almost entirely of magnetite. There was a deposit of black sand on the beach from this ledge when there was a southeasterly storm, which, on being tested, proved to be 95 per cent. pure magnetite. Can we wonder that ships go ashore off this coast on account of such magnetic influences on their compasses?

In reply to the statement of Mr. Woodbury that he had noticed in the daily press that an order had been issued by the management of a Western railroad to require improved time-pieces to be carried by all its trainmen, Mr. A. Conkling stated that such a proposition was under consideration by the road, but had not been adopted.

Adjournment followed, after the announcement that the next meeting would be held August 18th.



New Driving Gear for Dynamos.

New Driving Gear for Dynamos.

At a recent meeting of the Society of Telegraph Engineers and Electricians, Professors Ayrton and Perry described their new method of driving a dynamo with a very short belt. When such machines are driven in the usual way by belting, there is a certain waste of power in overcoming the friction of the driving spindle and its bearings, created by the pull of the belt, which becomes greater when the space is confined, as in that case the belt must be put on with additional tension. The usual method of driving dynamos by a horizontal belt has also the inconvenience of requiring considerable floor space, and to overcome these objections Professors Ayrton and Perry have devised a method of driving which is illustrated in the accompanying engraving. The dynamo is placed below the fly-wheel, its pulley coming within an inch or so of the periphery of the latter, and it receives motion from a very short belt, as shown. If the dynamo were rigidly fixed in this position, the initial tension of the belt would have to be very great indeed to transmit the necessary power; but by pivoting the whole frame of the dynamo in trunnions very smooth driving is obtained, with comparatively small tension in the belt and little strain on the spindle. Our illustration, for which we are indebted to *Industries*, shows a hole cut in the floor, into which is placed a fixed cradle having bearings for the trunnions *T*. The dynamo *D* is mounted in the cradle *C* hanging from these trunnions, and slots are provided in the cradle for shifting the dynamo in a direction at right angles to the axis of the trunnions, so that the weight can be more or less overhung on the pulley side, by which means the initial tension of the belt is adjusted. The dynamo is not placed plumb under the center of the fly-wheel, but to one side of the center line, so that the tight side of the belt forms a greater angle with the horizontal than the slack side. By suitably selec ing the distance from the center line, the component of the two tensions in the belt can be made to pass vertically upwards through the center of the pulley, thus relieving the bearing of the weight of the pulley and of that of a portion of the armature. An extra heavy pulley is recommended for this type of gear; and if it should be found impossible to put sufficient weight in the pulley, the dynamo can be shifted on its cradle in the manner above alluded to, so as to bring additional weight upon the belt.

Hatfield House is one of the noblest existing monuments of Elizabethan architecture. Yet it is to a remarkable degree fitted up with "all the modern conveniences" of the Victorian age. It contains probably the most elaborate and complete system of electric lighting in the world, there being no less than 500 lamps in the great marble hall, and 2,000 in the entire building. Spring water is supplied to every part of the house by an electric pumping engine, doors are opened and closed by touching electric buttons, rooms are heated by electric radiators, and elevators and dumb waiters run by electric power. The system extends to the barns of the great farm, where threshing machines, hay cutters, grain mills and all other mechanical devices are operated by electric energy. In fact, the whole place is a marvel of scientific equipment, contrasting curiously with the ancient architecture of the Hall and the oftentimes mediæval Toryism of its master's politics.

ELECTRICAL REVIEW

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The Mutual Carbon Manufacturing Company, in a circular to electric light companies, announces that contracts for 12,000,000 per annum are already assured, and says in relation to the late carbon combination: "Since the failure (credit be where credit due) of the combination, the country has been deluged with offers of carbons at various prices. The committee advises that no notice be taken of them, but that a representative of your company be in attendance at the meeting of the National Electric Light Association at Boston, August 9, 10 and 11, vested with power to contract, providing price and quality are satisfactory, and the committee feels fully justified in guaranteeing these conditions."

There is great and growing activity in the electrical business.

If so soon I was done for, what was I begun for?—*Carbon Combination.*

If you are not interested in electrical matters now is a good time to come in. Now is a good time to subscribe for the ELECTRICAL REVIEW.

Some very forcible and eloquent remarks from gentlemen who appreciate the unequaled value of this journal as a medium for reaching the electrical and general public appear in our advertising pages. The genial advertiser has a persuasive and winning way with him, yet our readers will observe that no encroachment has been permitted on the usual interesting and instructive reading pages of the REVIEW.

There are 100,000 telephone calls a day in the city of New York. There are thirty-six companies, with wires in different parts of the city, whose men are engaged on these lines at all hours; and the fact that an occasional "cross" occurs on a subscriber's line in this great city is not to be wondered at—the real wonder is that the seven thousand telephone lines are kept so clear. When all the wires are underground, we will all be happy, we hope; but we have our doubts, we have our doubts.

The new club house of the Electric Club at 17 East Twenty-second street is to be fitted up with electrical apparatus throughout. Electricity will be used in every conceivable way to be of advantage or convenience. Four systems of incandescent electric lighting will be used on the first floor—the United States, Brush-Swan, Sawyer-Man and Edison. Four large electroliers will be necessary to light up the large parlors and hall, and one will be lighted by each of the above well known companies.

At the Hemenway Gymnasium, Cambridge, Mass., the director, Dr. D. A. Sargent is giving a summer course in gymnastics and physical development. It has been suggested that the telegraph boys avail themselves of the opportunity for improving their wind and muscular activity. The time for the delivery of dispatches from a suburban station to a point a mile distant might be reduced from one or three hours to 15 minutes without permanent injury to the boys, provided they are first properly trained.

Already a number of towns and cities have applied to the Massachusetts Electric and Gas Commission for permission to install electric light plants in conjunction with their gas works. The gas companies last spring, through their New England Association, appointed a committee to visit plants of various electric systems adapted to long distance lighting and make a full report of their investigations. It is understood that it is quite favorable to the systems, and that the gas companies will at no distant day enter the business of supplying electric light and power as an essential part of their business.

THE CARBON COMBINATION.

A few short—very short—months ago an enterprising attorney of Buffalo perfected, as he thought, a combination of the carbon interests, and very promptly proceeded to put up the price from 50 to 100 per cent. This was rubbing it in. The consumers, the electric light companies, might have been willing to have paid a reasonable increase in consideration of the improvement there might have been in the carbon points produced. But the organization wanted too much. Leading consumers, with the president and other officers of the National Electric Association, met in New York and began arrangements to organize a mutual carbon company. Before this was completed the Pittsburgh Carbon Company, with a capacity of a million carbons a month, was sold to the Faraday Carbon Company; prices at once tumbled, and to-day carbons can be purchased as cheap if not cheaper than ever. That is why electric light men are happy now.

MOTORS AT THE CONVENTION.

Electric motors are to be well represented at the coming Electric Light Convention at Boston. Thomson-Houston, Sprague, Baxter, and Cleveland motors are to be shown in practical operation. The interest in electric motors displayed by existing and prospective electric light companies is, perhaps, greater than that ever occasioned by the introduction of the electric light itself. This is naturally so because the operation of electric motors has from the first been a source of greater profit proportionally than incandescent or arc lights after six years' experience in the methods of commercial supply.

CHANCES OF PROFIT IN THE ELECTRICAL FIELD THEN AND NOW.

The following letter tells its own story:

New York, July 12th, 1887.

To the Editor of Electrical Review:

SIR: One of the few things I shall regret in after life, when I come to look back upon my manifold sins and transgressions, my sins of omission and commission, will be that I did not take the REVIEW's advice long since and put my spare capital into electrical enterprises. You pleaded, I thought, at the time with something like insistency, that there were millions in this self-same electrical development, and you advised those who had patience, as well as spare capital, to trust themselves unhesitatingly upon the seas of electrical projection; for that, once clear of the shoals and rocks of experimentation, a golden harvest awaited them on not far distant shores. Then I thought you exaggerated the chances of profitable investment, but now I am not loth to confess that your prediction was an under-estimate rather than an over-sanguine one. Did you ever try to catch the last train on a dark, stormy night—a train that would bear you quickly to your own bright, comfortable fireside, where the happy faces of wife and children expectantly waited, and see it depart without you? If you have, Mr. Editor, you know what it is to "get left," and you can the better appreciate my feelings, as, looking in upon my friends who took similar advice to that which you dispensed so freely a few years ago, I discover them engaged in the comfortable and healthy exercise of clipping coupons from their electric light and telephone stock; a portion of which, at least, should have been mine. This is the kind of exercise I need; I have had some of it in my day, and know it to be beneficial in bracing up the waning forces and giving a healthy tone to a system not over robust at best. Yes, I could have got in on the "ground floor," but now, if I may judge from the quotations of electric light and telephone stock, in order to get in I must needs get a step-ladder and ascend to the roof; that, apparently, being the only place unoccupied by the investor. Sir, I am one of the "outs;" my only solace to wander, in perplexing confusion, like a perturbed spirit, among the throng smilingly receiving their dividends, or anon groping my way amid the whitened sepulchers of the "might-have-beens," like the last man, on the last day of the world, who, in the last rays of a quickly dying sun, crawls feebly toward his cabin, extracts therefrom the old jug, takes a long, deep, exhilarating draught, and goes to his grave with his legs tangled. Why continue to prate of electricity when the apex of profitable investment has been reached; the field covered, as other fields are covered, and profits simmered down to a normal basis! Are there no other forces of nature save electricity that can be popularly utilized to make men suddenly rich? If so give me the tip as quickly as possible, and think kindly of one who might have been

A CAPITALIST.

[I enclose my card].

We regret that our correspondent inclines to these gloomy forebodings. We tender him our sympathy, which, like charity, blesses them who give and them who receive, but which has the advantage over charity that it is inexpensive as well as abundant, though in this case it is a worthy motive that prompts us to give it to him. It may prove a balm to his feelings to assure him that he is altogether wrong in his summary of the present condition of the electrical field, and that he need not look to the development of other forces for a rich field. Instead of being full, it is a very desert of loneliness compared to what it is sure to be ten years or even five years hence. We do not hesitate to say of the electrical field now what we said at the time to which he refers. Indeed, the prediction of profit is safer now than it was then. Five years ago it took a sharp eye and a long head to see anything like quick-coming or abundant profit in electric lighting, because it was necessary to anticipate great improvements in the construction of the dynamo-electric machine and a smooth and even road through the maze that encumbered the path to economical distribution. Now this has been found, and more economical apparatus and better methods are appearing almost daily. Capital, always timid, has gotten over its fears, so far as electrical enterprises, especially as to electric lighting, motors and telephony; and money is lavished on the experiments so necessary to improvement of processes. It is not very long ago that the general public, led by a thoughtless and uninformed press, were afraid of the electric light. They regarded it as dangerous to life as well as to property. We said at the time that the public would get over this erroneous impression as soon as they were informed as to the true facts concerning electric lighting, and further, that not even the popular press, in which ignorance and maliciousness combined to libel the electric light, could keep the public much longer ignorant of its great advantages. We prophesied the day to be not far distant when the public would clamor for it, and when the electric lighting companies increased a hundredfold would not be able, running at their greatest capacity, to supply the demand for it. We now point to a chain of electric lights that sweeps the whole continent as a verification of that prediction. The great city of New York, the metropolis of the United States, is encircled by an endless chain of these lights, and its principal thoroughfares are resplendent in glories. Arrangements are now being made to altogether substitute electricity for gas in all the streets, and in every considerable city in the country, and, indeed, in every thriving town, a similar substitution is rapidly taking place. Good circumstantial evidence of the extent of electric lighting may be gathered from the fact that 50,000,000 or more carbons were sold to the electric light companies during the last twelve months. One New York company used 1,000,000 carbons last year, and its business is likely to be half again as large this year. Therefore it is that we say to our correspondent, and to all others who have money to invest, the electric light and electric power fields offer splendid chances for investment—better now than they did years ago; first, because the apparatus being perfected, generation and distribution is more economical; and again, because the public taste has been educated and is demanding these improvements. There are plenty of brains and capital already in the electrical field, and there is no end of room for more.

The reason that the enterprise of the West has been so evident in its rapid and extensive adoption of electrical appliances may be, in a very large degree, attributed to the wide-awake editors of that progressive part of our country. In the State of Kansas there is as great a number of these energetic fellows as there is in any other western State. They are largely men with pride in their cities and towns, who earnestly work for the general advancement of the community in all that benefits and instructs, and very naturally, later progress in electrical work receives much notice and patronage. A beautiful issue is that of the Clay Center (Kansas) *Times*, of July 13th, in which appears some sixty excellent cuts of the business houses and residences of the city. The publishers of the journal, Messrs. D. A. Valentine and J. P. Campbell, are made of the right stuff for editors, and their enterprise in publishing this magnificent edition is deserving of high praise. The citizens of Clay Center should appreciate such efforts and liberally support that which cannot fail to be of great value in attracting attention to their beautiful and growing city.

A New York messenger boy sails for Europe to deliver several messages for a couple of theatrical gentlemen. This will be the longest messenger trip on record, and wagers are being made that the boy will be a gray-haired sage on his return.

OUR CHICAGO LETTER.

(From a special correspondent of the ELECTRICAL REVIEW.)

On the Lake Shore and Michigan Southern road, between Cleveland and Erie, engine No. 411 has carried an electrical headlight for about one year, the invention of Mr. Howard L. Pyle. The stories of its success, which have grown to be giants in that twelve months, show what an excellent soil that locality has for the development of electrical Munchausenism. A reporter says, "A newspaper can be read by its light four miles away, and time read on a watch nine miles off. Its reflection is seen on the clouds twelve miles distant." Please pass the fans.

Over in Oskaloosa, Iowa, there was a tussle for the lighting of the town—a case of gas *vs.* electric light. The contract for lighting the streets was won by the local Edison Company.

The semi-annual meeting of the Edison people takes place the second Wednesday in August. There should be some sort of a compromise entered into, so that those who are members of both associations, or desire to attend both, should have an opportunity. Why not?

In one of the windows of the Eagle Clothing Company here, there stands a very finely executed memorial of young Holland, who was so suddenly killed by electricity a short time ago. The memorial is from the employes of the Chicago Telephone Company. A very fair likeness illuminates the plate, which is quite large. The whole is done with pen and ink, and the execution is very creditable to the artist, Mr. H. F. Vogle.

Commodore Barrett has been in his element for the past few days inaugurating the handling of the bridges by telephone. Directly over the tunnel on the north side of Lasalle street, a gay little house has been built, just back of the water line, with a porch and other conveniences, such as switchboards, telephones, magnetos, and the like, and the whole outside outfit painted a beautiful crimson shade. The reason for giving it this color was to have a hue which marine blasphemy would not spot. From this little home of the Admiralty, wires are run to the various bridges to the north, south and east, terminating in the fo'c'sle of the bridge. The vessels aggregate until a sufficient number have bunched, and the man in the fo'c'sle rings up through his line to the admiral or the commodore, who gives the order to weigh anchor and make headway. "Aye, aye, sir!" says the jack tar on the bridge. The skipper rolls his quid, mounts the pilot house, and pulls the whistle cord. Round goes the bridge, the fleets move up and down from both directions. The plan makes good time, too. On the second morning of the new system a fleet of seven vessels passed up and five passed down, and the bridges were not open over eight minutes. What was equally a success was the complete suppression of the whistling, which had grown to be an utterly unbearable nuisance.

There was one day an incipient rebellion. A skipper concluded he had been detained long enough, and undertook to go through anyhow. He was served like a boy in a spelling class who misses—he went to the foot and tied up, awaiting orders. It was bitter medicine, but he took it.

There were a few hitches in the system at first, but as a whole the scheme works like a charm, and pretty soon everybody will be satisfied.

Lacking a quarter deck, the commodore walked the dock in front of the home of the admiralty, looking every inch the sailor that he is; and a wave of the magic wand he carried, in lieu of a sword, was as potent as a pilot's signal to the engineer of a tug.

The position of dispatcher has been given to Capt. Napier, an experienced marine man, who will assume control at once, when the commodore will retire on half pay. A proposition has been made which will prevent much confusion. Certain bridges have been selected which will signal to others their opening. That is when one of these swings, the bridge next in the line of the fleet's progress will consider that movement an order, and open unless otherwise directed, which will be the case where a vessel makes a wharf between bridges.

Here comes another new telephone. Extracting from some reporter's description the public learns that this "telephone's diaphragm has a projection on its back"—*ergo* it is humpbacked. "A ball about the size of a pea rolls down an inclined trough and rests against it"—the hump. "When the ball rolls down against the projection the circuit is complete, and a current passes. When the ball is kicked up the trough by an outward vibration of the diaphragm the contact is destroyed and the circuit is broken. Then there is no current."

Another electrical mugwump says: "The experiments with the new telephone are said to have been remarkably successful. * * * Another great advantage claimed for it is that a current of any strength can be used and the transmission is equally far-reaching, so that a powerful battery current, where it is necessary, can go along about its work without any danger of interference from electric light or telegraph wires." Remarks from Messrs. Vail, Sargent, and Lieut. Toppan will now be in order. As Capt. Cuttle would say: "They is men as kin give a nopinion—they kin, if any men kin, they kin."

The Edison people here have a franchise which permits them to go pretty much anywhere they desire, having first obtained property owners' permission and a commissioner's permit.

At the request of the street department a few days ago, they furnished a schedule of points where they would eventually desire to lay their underground system. This was done with an eye to putting their work in at such times and places as would be the most convenient and economical, and with the understanding that the company would be notified when streets were to be torn up for paving, etc., that two bites should not be made of one cherry—or that one tearing up should answer for two purposes.

The commissioner unluckily went out of his office without having first attached an explanation, and a reporter caught a glance at the scheme. His head whirled with the excitement consequent on getting the "scoop." Next morning the public was informed that "both sides of every street in the district bounded by Randolph street on the north and Van Buren street on the south, State street on the east and Franklin street on the west, are to be torn up during the present season by the Western Edison Light Company. At all events, the president of that company yesterday made a demand on Commissioner Swift for permits to tear up these streets, and under an ordinance adopted March 28, 1877, drafted by Mayor Harrison, the commissioner will be compelled to grant them."

The rest of the reporters followed suit, and by dark the next day it began to be problematical whether the entire property of the city wouldn't be put up in large blocks at acre prices, so suddenly and so thoroughly was the contemplated ruin to be effected. It blew over and the commissioner has filed the request in a private drawer, while the reporter is snooping round for a fresh sensation.

At the next meeting of the council it is expected there will something be done in the matter of taxing or licensing the Chicago Telephone Company. It is understood an ordinance is now in the hands of the corporation counsel.

Opposite the little red home of the admiralty, there is a more pretentious structure in course of erection. This building is an adjunct to the fire department, and is to one of the fire boats what an engine house is to a steamer. It, too, stands upon the river bank, and will contain everything in the way of conveniences for the river fire boys that they can ask. Nice airy bedrooms, bath, incandescent lights, connections with fire and police headquarters, both signal and telephonic, cupboards and clothes closets, everything to make home happy but wives, babies and puff powder.

Mr. N. N. Webster, of the United States Company, has recently returned from Yellowstone Park, where he has been superintending the installation of an incandescent plant of 250 lights in the Mammoth Hot Springs Hotel.

W. Chandlee, agent of the Gamewell F. A. Telegraph Company, whose district extends over parts of Indiana and Ohio, recently secured the contract for a fire alarm plant at Goshen, Ind., and another at Newark, Ohio.

The Mount Vernon Electric Light and Power Company, at Mt. Vernon, Ill., with $10,000 capital stock, was recently incorporated. The object is to light the city and furnish power. A. C. Tanner, G. W. Evans, Morris Emerson and others, incorporators.

CHICAGO, July 25, 1887.

OUR BOSTON LETTER.

(From a special correspondent of the ELECTRICAL REVIEW.)

It is rumored that a large central station operating an alternating system is to be built somewhere near Washington street in the central portion of the city. At present the business portion of the city can be reached by the Edison Company from the Head place station or the new one in process of construction at the north end, or by the Sun Alternating and Weston Series Multiple operated by the Boston Electric Company.

The man with the project to get power from water alone comes up more persistently than a Cape Cod mosquito. He proves beyond question that if power can be obtained for nothing electric light will be very cheap. He believes there's millions in it.

There is in a New England town a spring of pure soft water. By years of exertion the proprietors have created such a sale for the water that the profits run way up into the thousands, and is said to cure every disease that can be imagined. The unfortunates who hope to run a train with a cup of water are advised to visit the springs and drink this water, unless they already have too much on the train.

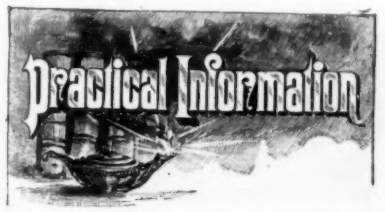
A gentleman well known in engineering circles has completed a dynamo with a novel arrangement of laminated iron for the field magnets. The electromotive force is over 30 per cent. higher than was expected, the computations being made from the data given for similar machines having solid wrought iron field magnets.

The spacious rooms of the Electric Club at 66 Boylston street will be ready for occupancy during the first week in August. A novel feature in the decorations will be a tiled fireplace of a design in keeping with the purposes of the club.

A gentleman who has recently returned from New York, where he has been studying the problems connected with rapid transit in large cities, said to a REVIEW reporter: "You are putting off the question of elevated railroads in Boston for a few years only, if the tunnels and extensions proposed by the West End Railway Company are carried out. They will in some degree relieve the blockades, but rapid transit will not be obtained. The elevated railroads in New York are taxed to their utmost capacity in carrying passengers during the crowded hours, and the question of employing electricity as a motive power is forced upon them by the necessity of using six car trains. The Broadway cars are crowded and the facilities are still insufficient, and an underground road is only a question of time.

The pressure brought to bear by the general public upon legislators to influence underground legislation is a vanishing quantity. The experiments of the telegraph, telephone and electric light companies in underground work in this city gave the city fathers reason a few weeks ago to make a visit to New York and Philadelphia. They have returned completely puzzled. Iron, wood, concrete, cement, and brick conduits there are in the field; and insulating compounds without number, some of which are exceedingly hard—to spell. The problems of induction, conduction, etc., have given the committee enough to think about for months to come.

Boston, July 26.



Galvanometers, including ammeters and voltmeters, can be made dead beat, so that the needle will come quickly to rest, by:

1. Attaching to the needle a vane which dips in water or glycerine.
2. Confining the needle so that a considerable resistance is offered by the air enclosed.
3. Employing a strong magnetic field, and, consequently, artificial or electro-magnets.
4. Surrounding the needle itself as closely as possible by a mass of copper.

In a prosperous New England village a multiple series system, consisting of two arc light dynamos and regulator boxes, was installed by the Arc Light Company. For a time all worked well. Then came the report that some customers were dissatisfied with the amount of light they received, and that the breakage of lamps was enormous. One of the parent company's experts was sent to examine. He found that while the normal current for the circuits was ten amperes, one was 8 the other 13. On the first the lamps were far below candle power, on the other the lamps broke rapidly. There was no station ammeter. Whatever failure there has been in multiple series lighting has been due in a great measure to the want of accurate ammeters. One might as well do without a steam gauge on a boiler.

According to M. Duter, in the electrolysis of aqueous solutions of the hydrates of any of the alkalies the volume of oxygen disengaged is always sensibly less than half the volume of hydrogen. The discrepancy augments as the size of the positive electrode is increased in comparison with the negative. When a large sheet of platinum was used for the anode and a fine wire for the cathode, one volume of oxygen was obtained for *four* of hydrogen. It seemed probable, therefore, that some new oxygen compound was formed in the electrolyte, and, if so, probably the condition which would most favor the continuation would be that of a very dilute solution traversed by a feeble current for a long period of time. In an experiment the electrodes were separated by a porous partition, and after a current of 0 3 ampere had passed through the solution for several days, some of the liquid around the anode was drawn off, and heated nearly to the boiling point. Oxygen came off freely. In repeating the experiment with each of the alkalies in turn it was found that the proportion of oxygen evolved was sensibly constant. The oxygen cannot exist in the form of a simple solution, for it is less soluble in the alkalies than in pure water. After the gas has ceased to come off from the heated solution, a further quantity is evolved on the addition of a small quantity of acid. It appears probable that the oxygen exists in the form of peroxide of hydrogen.

QUERIES AND ANSWERS.

To the Editor of Electrical Review:

Is it necessary or advisable to amalgamate the zincs of a Leclanche cell? INQUIRER.

ANS.—Theoretically it is not necessary if the chemicals and zinc used are pure, but it will in some degree prevent the formation of crystals. There is necessarily a difference in specific gravity of the different layers of solution in the jar, and the zinc is slowly dissolved from one part and deposited on another part of the rod. This may explain the troublesome wearing away of the rods at the surface of the water.

In some forms of bichromate batteries a red coating of chromate of mercury appears on the zinc if there be an insufficient amount of acid in the solution.

To the Editor of Electrical Review:

What is the expense of running the oxide of copper battery? STUDENT.

ANS.—The oxide of zinc formed during the working of this cell is worth as much per pound as the original zinc. The liquid, a solution of caustic soda or potash, is, unless the cell be air-tight, changed by the carbonic acid gas of the air to carbonate of soda or potassium, and must be replaced by fresh solution or restored by the addition of unslaked lime.

Telephonic News

*** The Brooklyn telephone exchange will soon move into new quarters.

*** The Boston Telephone Company has just made a large purchase of underground cable of the Patterson make.

*** The phonograph is likely to come to the front again—this time as a practical and useful instrument, having been greatly improved by its inventor.

*** Prof. Gray's telautograph is said to enable a man to sign a check a thousand miles away. It would greatly aid some of us, Professor, if the apparatus would cash checks for us.

*** The "telephone ear" is receiving much attention in the press at the present time. It is generally a pretty good ear, but has difficulty sometimes in understanding when asked the question, "Can you pay that bill?"

*** The telephone subscribers at Butte, M. T., were disturbed a little last week by the changing of the wires to the new office pole and re-arranging of the lightning arresters. The trouble only lasted a few days, and now all is peaceful at Butte.

*** A German paper states that: 'Two young men in Munich, Mestern and Helldober, technical electricians, have patented a remarkable improvement in the telephone. They have invented a process by which words and sentences can be transferred directly to a chemically prepared paper. A peculiar form of writing is employed by them, more akin to phonography than to our customary alphabetical symbols. This is approaching the long-desired instrument, a practical phonograph which will enable us to print in a legible form our words as spoken, thus performing by a single mechanical operation the work of the lightning, stenographer, and type writer. Let us hope this announcement foreshadows such a blessing to humanity."

Accused of Running a Private Telephone Exchange.

A special dispatch from Lowell, Mass, says: Russell Clifford, a Shattuck street jeweler, has been arrested charged with a novel crime. It is alleged that he has stolen large quantities of electricity from the Local Telephone Exchange. The first offense, it is set forth, was committed by tapping the wires of the telephone company and the next by tampering with the company's meter.

For some months the local managers of the telephone company were convinced that many parties were using the wires without paying rental, but the inspectors and clerks were unable to detect them. Clifford, who was detected fourteen months ago tapping the wires of the company on Shattuck street, was one of the suspected parties, and stories were told the officials that he was running an independent telephone enterprise. On a recent stormy evening one of the young lady operators discovered that her wire had been crossed in a peculiar manner. She also found that she was talking with strange persons who were not regular subscribers. The fact was reported at headquarters, and the telephone officers have ever since been investigating the case. It was not until Clifford's arrest, however, that the mystery was solved. From an investigation then made the telephone officials became convinced that Clifford obtained some telephones formerly used by W. N. S. Davis, a local inventor, and hired them to regular subscribers. The directors and local superintendent refused to disclose the manner in which Clifford worked his independent exchange. They claim to have knowledge, however, that he had three lines running from his shop to various points in the city. It is alleged that he had a dozen patrons. Clifford denies that he has been running a rival exchange, but admits that he tapped the wires of the telephone company.

The Paris-Brussels Telephonic Line.

Respecting the working of the telephonic line between Paris and Brussels, opened for public use on February 24th, M. de la Touanne gave a most interesting communication to the International Society of Electricians, on May 4th, adding some figures and diagrams relating to this important installation.

Overhead Line.—Total length of wire (double line), 628 kilometers. Silicious bronze wires in France. Phosphor bronze wires in Belgium. Diameter, 3 millimeters. Breaking strain, 42 to 45 kilogrammes per square mm. Conductivity, 96 to 98 per cent. of pure copper.

Underground Cable.—Fortin-Hermann cable, a cable of copper wires, on which are strung beads of paraffined wood. Capacity, about five times less than that of ordinary cables without gutta-percha, or 0.045 to 0.04 of a microfarad, per kilometer. The insulation resistance has reached as much as 10,000 megohms per kilometer.

Microphones and Telephones.—At Paris, D'Arsonval transmitters, with D'Arsonval or Aubry receivers, Lalande and Chaperon batteries. At Brussels, Berliner or Dejongh microphones, Bell receivers and Warnon batteries.

Communications between the stations established at the Bourses of Paris and Brussels offer no difficulty as regards installation. Without excepting the employment of simultaneous telegraphic and telephonic communications, they come into the ordinary case of two stations, *A* and *B*, connected by a double wire, which is most simple.

With regard to communications between town subscribers, special arrangements have been made to ensure a good service.

Communications between Town Subscribers.—Until further orders, the office of the *Avenue de l'Opera*, Paris, will establish communications between the subscribers and the Paris-Brussels line. For this purpose a special telephonic cable connects the office of the *Avenue de l'Opera* with the Bourse office. The connections with the subscribers at Paris that possess the double wire will be direct, without any derivation. But the correspondent must be able to indicate the end of the conversation.

As the line is cut by two condensers, we must not think of giving a signal on the telephonic line by a continuous current, any more than we must change the order of things by modifying the station of each subscriber.

The notice of the end of the conversation is given at the Bourse station by an electro-magnet, *A*, presenting a large coefficient of self-induction, playing the part of an annunciator, and placed in derivation on the wires coming from the *Avenue de l'Opera*, in front of the condensers C_1 and C_2. This annunciator in no way interferes with telephonic communications characterized by alternating currents of very short periods, for which the electro-magnet *A* constitutes an impassable derivation.

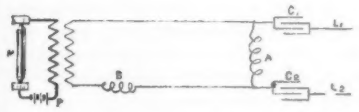


FIG. 1.—S, subscriber; A, Bourse; B, Avenue de l'Opéra office. Arrangement of the telephonic circuits enabling the end of the conversation to be indicated at the Bourse and the Avenue de l'Opéra.

It still remained to notify to the office of the *Avenue de l'Opera* the end of the conversation. For this purpose the *Societe Generale des Telephones* proposed to employ a relay, invented by M. Ader, and this suggestion has been adopted. This relay consisted of a slight coil, placed in the magnetic field produced by a permanent magnet, and closing, during its action, a local circuit. This bobbin, introduced into the circuit, having only 50 ohms resistance and a low coefficient of self-induction, in no way impedes telephonic transmission. The end of the conversation being thus announced simultaneously at the Bourse office and at the *Avenue de l'Opera*, there is no need to transmit messages, which would occasion loss of time.

Subscribers Connected Directly with the Bourse.—A certain number of subscribers possess lines connecting their residences directly with the Bourse. If the subscriber lives at a distance, it would be necessary, in order to call him, to employ a powerful battery to magnetize his annunciator placed at the Bourse; but this would give rise to remanent magnetism, which would be injurious when the subscriber, in his turn, wished to communicate with the Bourse office. This difficulty has been obviated by communicating with the subscriber directly, by means of a magneto-electric machine placed at the Bourse, working the subscriber's electric bell, which itself communicates with the Bourse by its normal battery. By using this combination, the annunciator of the Bourse never retains any injurious remanent magnetism.

Simultaneous Telegraphy and Telephony.—Besides acting as an entirely metallic telephonic circuit, each wire serves for a distinct and simultaneous telegraphic communication returning by the earth. Fig. 2 shows the connection between the apparatus, allowing of these communications according to the Van Rysselberghe system on the circuit L_1. *A* is the graduating electro-magnet, *C*

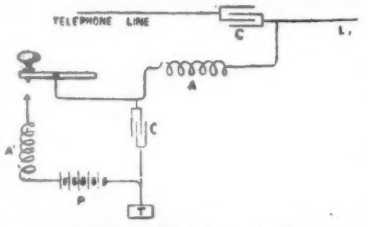


FIG. 2.—Arrangement allowing of simultaneous telegraphic and telephonic communications.

a condenser, *A'* a graduating bobbin, and *T* the earth. The arrangements of the circuit L_2, which serves for a second telegraphic communication, are exactly similar.

Telephonic Signals between Paris and Brussels.—The signal between Paris and Brussels cannot be made by means of direct currents. M. Sieur had at the beginning suggested to M. Van Rysselberghe a special mode of signaling known as the phonic signal. This consists of the membrane of a telephone, the bobbin of which is connected with the line after the condensers. On this membrane

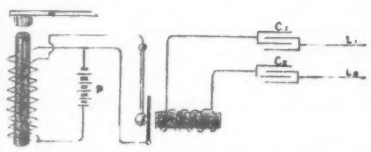


FIG. 3.—M. Sieur's phonic signal with M. de la Touanne's differential annunciator.

rests a pendulum, moving very freely, which, during rest, short-circuits a local battery. On this local battery branches a local bell, not traversed by any current. If we send currents into the line, the membrane vibrates, breaks the local circuit, and sets the bell ringing.

This local battery, which is almost always short-circuited, is subjected to considerable wear and tear, which M. de la Touanne has succeeded in reducing, by modifying its arrangement.

For this purpose he employs a differential annunciator. One of the circuits of this annunciator is closed directly upon the battery, the other indirectly, through the pendulum and the membrane. When at rest, the actions annul one another, whereas, if the membrane of the phonic signal vibrates, the action of the direct circuit predominates. Under these conditions the battery of the relay, instead of being closed on short-circuit, works upon two resistances in derivation, and the loss is only slight.

Such are, briefly, the arrangements adopted at Paris, in order to establish communication between the subscribers and the Paris-Brussels line.

Those employed at Brussels are, if not identically the same, at least equivalent.

On busy days at the Bourse as many as eighty communications have been made in three hours, and from thirty to thirty-two so-called five-minutes communications during the busiest hour.

The Paris-Brussels telephonic service thus constitutes an excellent means of communication, and is so fully appreciated that there is a second line to be established, similar to the first, which has become insufficient. What better proof can be given, says "E. H.," in *L'Electricien*, of the efficacy and utility of communications between towns?

The Telephone Service in Newark.

A special meeting of the board of directors of the Domestic Telegraph and Telephone Company was held at the office of the company last week to consider the complaints made against the telephone service in this city. All the members of the board were present, and after a full discussion the following statement to the public was authorized:

"The directors of the Domestic Telegraph and Telephone Company desire to say to their patrons that the difficulties which for some time have impaired the service have been caused by the removal to more commodious quarters, and a change in the methods of switching, all rendered necessary to provide improved facilities for the immediate requirements and future growth of the business. Such a change, under the most favorable circumstances, makes temporary trouble, but when operators are to be educated in the use of new apparatus, and the unforeseen mechanical faults of that apparatus rooted out, such trouble became serious. Another difficulty arises from the fact that the wires and apparatus have been in use many years, are to a great extent worn out, and need thorough overhauling and renewing. Much of this has been done and the work is still going on. The removing of wires is liable to make 'crosses' and interferences while the work is being done. Hence the many complaints of being able 'to hear other people's conversation.' Among the improved facilities contemplated and shown to be necessary are additional trunk wires connecting with New York, Jersey City and Orange. The work of stringing these is now in active progress, and when completed they will greatly relieve the pressure of business that now exists

"The directors desire to assure subscribers to the telephone that every possible means is being used to remedy existing sources of complaint with the service. In its efforts to that end the company has already incurred heavy expenditures and has secured the aid of the most skillful experts now engaged in the telephone business.

"It being the intention to bring the telephone service of Newark into perfect working with the systems of the neighboring cities and towns of the State, the local management has called to its aid Mr. W. D. Sargent, general manager of the New York and New Jersey Telephone Company, who has large and valuable experience in the organization and management of exchanges in Philadelphia and Brooklyn, and now has charge of a telephone field embracing about 6,000 subscribers. For two weeks past he has devoted his personal attention to remedying troubles in Newark, and although the changes effected by him have been in operation only during the last three days, the directors are confident that the worst is past, and that the improvement so generally acknowledged during the past few days will continue, and that the service will steadily grow better and better from this on, until a proper standard of efficiency is assured. Mr. Sargent will continue his personal attention and supervision."

The citizens of Newark have every reason to be satisfied with the present outlook for their telephone service. A more practical, well-informed telephone man than Mr. Sargent is not to be met with in telephone circles. He will vastly improve the Newark exchange, but the patrons should realize that this is a class of work that has to be carefully and thoroughly done, and it will take several weeks, if not months, to complete the improvements proposed.

Electricity for "Roarers."

The application of electricity to cure race horses of "roaring" has been almost completely successful in the case of Ormonde, the unbeaten English champion and undoubtedly the best horse of the century. When his wind was affected at the end of last year's racing season it was said his further usefulness was destroyed. His two recent wonderful races prove him to be the Ormonde of old and display the wonderful power of electricity once again. The London *Sporting World* describes the process in this way:

"Two applications, each of five minutes' duration, are given daily, and the force is increased or diminished, as needs be. It takes five human beings to conduct this important operation. Little Nippa holds the machine, 'Viney' 'twitches' the horse's nose, Mr. Porter, junior, 'my son George' and Gallantry apply the current, and Marlow holds his charge's head. He stands it all like a lamb, and, to judge from the expression of his eyes, seems to like it rather than otherwise. I am told, however, that on occasions he will resent the operation, and only last Friday, the day before his 'reception' at the Grosvenor House, in the absence of the 'twitch,' not applied that day as an experiment, 'went for' Cartwright, whom he seized by the arm, without doing material damage, however."

OUR KANSAS CITY LETTER.

(From a special correspondent of the ELECTRICAL REVIEW.)

The Union Street Car Company, at St. Joseph, Mo., has its power house all complete; the boiler and engine are in place, and all that now remains to be done is to attach the motor to the cars on its arrival. In two weeks the management propose to have the north part of the line in operation from the Union street car works, one and one-half miles north. "If the trial on the north end is as successful as we anticipate," said one of the officers of the company, "we will have the whole line in operation by the opening of winter."

Prof. John C. Henry has taken the contract for the manufacture of all the machinery to be used in the San Diego, California, Electric Railroad Company. Dr. Granchenor and Juan Francesco, president and vice president of the company, were in this city last March and witnessed the experimental trip of the electric motor in this city, and were so highly pleased with it that they determined to give Prof. Henry the contract for the machinery.

James Genger, a fireman of the electric light company, of St. Joseph, Mo., while explaining to two of his friends the workings of the dynamo, happened to touch the brass rod which connected it with the positive wire. He was unable to withdraw his hand, and fell over on the machinery dead. His right thumb and forefinger were nearly taken out by the roots, and the back of his hand was fearfully lacerated.

Mr. E. L. Martin, president of the Pacific Mutual Telegraph Company, recently said to your correspondent that the Pacific Mutual Telegraph Company would enter into no combination with any other company. The company is now on a paying basis and is not mixed up or entangled into pools or combinations, and it is the intention of the company to remain so.

The electric light company at Hutchinson, Kansas, has increased its business to such an extent that it orders carbons in lots of 50,000 at a time. This tells the story of the popularity of electric lights.

Atchison, Kansas, has abundant reason to be proud of its electric light plant, which is conceded to be one of the best in the West. Every day inquiries are received as to the cost of the incandescent lights for residences, and the inquirers are invariably surprised to find that they are so cheap.

Pratt, Kansas, will soon be illuminated by electric lights.

The electric light building at Hastings, Nebraska, will probably be completed in sixty days. Six dynamos will be put in at the start.

A gentleman living on the line of the electric railway has a watch which created considerable wonder in his family, after its owner rode in the electric car, too near the motor, during a rainy day last week. For awhile the watch ran too slow, then there was a hitch, and it stopped altogether. This lasted only a short time, when the works began moving again at such a rapid rate that the motion of the minute hand was discernible. Between breakfast and supper one day the watch gained an hour's time. During the night following there was a hitch in the movement, and a half hour had been lost when the time-piece was consulted in the morning.

All this time the owner of the watch, could not account for its strange conduct.

He visited a jeweler, who inquired, after examining the time-piece:

"Haven't you been too near to some dynamo or strong electrical current?"

"What do you ask me that for?" said the puzzled owner of the watch. "I don't see what that has to do with the case."

"The electricity has magnetized some of the metal in the works, and has caused the injury," said the goldsmith. "There is only one way to repair this, and that is to have another current applied, which will exert just an opposite influence. I do not think you can have the proper repairs made in this city."

Another jeweler, speaking in regard to the matter, said:

"I don't believe so much in the curious antics which some people say their watches play after coming under the influence of electricity from a dynamo or electric engine. I have rarely seen the matter clearly explained, but my opinion of it is that the electric influence can only accelerate or retard a watch's movements. For instance, electric clocks are capable of running a long time without attention, but when moved by electricity alone, are not very regular in movements, owing to slight irregularities in the electric currents. Electricity is often used as a method of regulating ordinary clocks. It is capable, when properly applied, of rendering important service in making ordinary clocks do accurate work. For example, an astronomical clock of great precision is connected in a proper manner by telegraph wires with a great number of common clocks which required regulating. The trouble with the man's watch affected by a ride on the Fifth street electric car was that he got too much electricity. Hence the watch goes too fast. Now, if one of the common clocks has gained or lost a small interval of time, the electric current is found in practice to retard or accelerate the motion just enough to correct the works and to impart to all the common clocks the precision of the astronomical clock."

Messrs. K. Sawai and M. Jkeda are two Japanese who arrived in this city last week, and departed soon for the East. They have only been in this country about two weeks, but speak English fairly well, having studied it before coming here. They came to study the subject of electricity and electrical machinery.

The Inter-State Electric Company has obtained the exclusive license to operate in the State of Kansas and in Western Missouri, using the storage battery of the Electrical Accumulator Company.

These accumulators are at the company's office, where there are also a dozen or more incandescent lamps in operation.

The company intends to soon open a general depot in this city for the sale of every thing pertaining to electric plants of this description. G. M.

KANSAS CITY, Mo., July 21.

Police Commissioner Carroll's Telegraph Investigation Winds Up Very Abruptly.

When Manager Thomas H. Rochford, of the Postal Telegraph Company, made the charge that there was a deal between the Police Telegraph Bureau and the Baltimore and Ohio Company, he was red-hot for an investigation. Last Thursday he was not present with his witnesses, and Commissioner Carroll had to adjourn the inquiry until yesterday. As he did so he turned to Deputy Commissioner Dallon and said: "Write a letter to Mr. Rochford and give him to understand that he has got to be here to make me believe that these charges were made in good faith." Still Mr. Rochford did not come, although Col. Carroll came down from Southold to conduct the inquiry. Supt. Frank C. Mason, of the Police Telegraph Bureau, had witnesses ready to disprove Rochford's previous statements, and others to show that the Postal Company had been running wires without authority from the Department of City Works.

"I think this is nothing less than an outrage," said Supt. Mason. "I was spending my vacation with my family at Richfield Springs when I was called down to answer charges that have no foundation in fact, and were made through spite. Now my vacation is frittered away by reason of these adjournments from week to week. Besides that, I'm out nearly $100, because I have had to break engagements and pay three or four railroad fares.

"The Postal Company," added Supt. Mason, "has been stringing wires along Flushing avenue, over housetops, without a permit from the Department of City Works. Not only that, but they have run wires and placed call-boxes all over the Wallabout Market without a permit."

"Well, all we've got to do now is submit the testimony and the conclusions resulting from this inquiry to Mayor Whitney," said Col. Carroll, "and let him see whether there is anything like a deal in our department with outside companies."

There the matter rests, with the Police Department victorious.

Determination of the Speed of Propagation of Electricity in Telegraph Wires.

The instrument used for the measurement of the time was the comparator of Lissajous, by means of which the difference of phase of two tuning-forks, vibrating in planes at right angles to each other, can be determined. The slightest alteration in the difference of phase is at once shown by an alteration in the shape of the figure. The first tuning-fork was placed with its axis in a horizontal plane, and the plane of its vibrations was vertical. To one limb of this fork was fixed a small piece of tinfoil, which could be brilliantly illuminated. The second fork, adjusted to exactly the same number of vibrations as the former, was fixed with its axis vertical, and so that the plane of its vibrations was horizontal. One limb carried the object-glass of a microscope, through which the brightly illuminated tinfoil could be observed. The two tuning-forks were joined up in circuit with a battery and the line to be experimented upon; and by means of a special mercury commutator the line could be put into circuit after the two forks, or between them. In the former case the figure of Lissajous kept its normal shape; but in the second case, when the current took time to pass through the line from one fork to the other, the shape of the figure was altered.

In order to judge the amount of this alteration, the section of an ellipse was drawn on the surface of a vertical glass cylinder, and by rotating this cylinder more or less on its vertical axis, the figure given by the tuning-forks could be reproduced. The angle through which the cylinder was turned was thus a measure of the retardation of the current.

The experiments were made at Bale, over circuits looped at various stations. These circuits did not consist of the same sized wire throughout; but the various sizes were all reduced to equivalent lengths of 4 mm. iron wire. The results may be tabulated as under:

Line looped at	Reduced Length. Kilometers.	Rotation of Cylinder.	Retardation. Seconds.	$10^{10}\frac{l}{\tau^2}$.
Lucerne	284.8	81°	0.00176	217
Olten .	157.5	24°	0 00052	210
Si-sach	115.8	14°	0.00030	226
Liestal .	97 6	10°	0.00022	227

The author deals at length with the theory of the question, and he states, as the "law of charge," that the duration of the charge is independent of the absolute value of the potential; and with respect to different wires submitted to the same relative limiting conditions, the duration of charge is proportional to the square of the length of the wire, and to the capacity and resistance of unit length. This is shown in the last column. The article also contains a review of all previous experiments by other persons on the same subject.

*** A company has been formed at Montreal to be known as the Dominion Subway Company, with a capital stock of $100,000, for the purpose of constructing, maintaining and operating underground conduits or other apparatus for conducting underground electric and other wires. Incorporation will be sought from the Dominion Government.

*** The Erie Telegraph and Telephone Company is putting up a number of fine telephone poles from 55 to 86 feet high, on Nicollet avenue, from Twentieth street to telephone headquarters, Minneapolis. They will carry 240 wires. The top wires, as less likely to be interfered with, will be for the fire department, and the increased height will carry all all the wires out of the way. The work is all being done at night.

TELEGRAPHIC

.... The B. & O. has arranged for a quadruplex between New York and Trenton, N. J.

..... One hundred members of the House of Commons have formed a committee for the purpose of endeavoring to cheapen the postal and telegraph charges between the mother country and the colonies.

.... Mr. D. H. Bates, President and General Manager of the Baltimore and Ohio Telegraph Company, declares that there is no truth in the rumors current in Wall street that the Baltimore and Ohio lines have been sold to the Western Union.

.... The Rocky Mountain Telegraph Company will open an office in Butte inside of a few days and be ready to do business between Butte and the rest of the world. The wires are all strung into the city. There is a gap between Helena and Deer Lodge that was supposed to have been the malicious work of Mormons, but that will be mended at once. An office for the company will be selected, an office corps engaged, and then Butte will have competition in rates and a much needed improvement in service.

.... The recent Hawaiian revolution has brought to public attention in a very forcible manner the defects at present existing in the mode of the transmission of official communications from our ministers there, in China and Japan to the authorities at Washington. Not merely is there no telegraphic communication with those countries, but communications when reaching San Francisco are forwarded thence by mail, consuming six days in transit, and six more for orders or instructions given in reply. In these days of almost universal telegraphy, such a delay may well work at times serious injury, and when, as in political or diplomatic crises, time is the essence of the matter, such delay might be fatal.

.... The status of telegraphic communi cation on the Pacific coast is bad in regard to Alaska. This territory has already acquired a considerable importance, not merely by reason of its fisheries, but still more so on account of its mineral resources, the development of which is hardly begun. This territory is at no point connected by telegraph with the rest of the country, and hence, no matter how seriously our interests there might be imperiled, days and weeks must be consumed in making known the facts to the department at Washington and the forwarding of instructions from here. Such a condition might be pardoned were the nation on the verge of bankruptcy, but with the rapidly accumulating surplus it is absolutely without excuse.

.... While it has always been the policy of our Government to leave such affairs as the maintenance of lines of telegraph entirely to private enterprise, the power of the Government to construct and operate has frequently been claimed, for the same reason that led to the transfer of all matters connected with the mails to the general Government. It has been repeatedly urged that the power should be exercised and the experiment made. For experimental purposes the transfer of the telegraph systems of the country is rather an extensive one; but in the case of Alaska and submarine cables in the Pacific it could be fairly tried, and while affording the safest and best guide as to the policy of placing all telegraphs under governmental authority, would furnish the departments with the means of communication that is now so sadly lacking. It might not, and probably would not at the start, pay the cost of operating, but the same was for years true of the Post Office Department, and even if it did not, the increased advantages to the Government would more than compensate the sum annually required to make up the deficiency.

ELECTRICAL AND SCIENTIFIC

* * A scheme is being agitated for the connection of Marlboro and Hudson by a belt line of electric railroad, Boston and New York parties being interested, it is reported, in the scheme.

* * A car driven by Sprague motors and Julien storage cells will be tried next week on the Cambridge Railroad. After a few experimental runs it will be regularly employed in carrying passengers to and from Boston, with a view of thoroughly proving the advantages of this form of motive power.

* * The label on canned peaches will still be "fresh," though it be ten years' old. There is at a seaside resort an electrical railroad about one-quarter mile long, carrying passengers at the exhilarating speed of 5 miles an hour. One seldom takes a second trip. A sign still stands at the station: "The Only Electrical Railroad in New England."

* * The Methuen Company, Methuen, Mass., have placed an order with The Stilwell & Bierce Manufacturing Company, Dayton, Ohio, for a pair of their 25" Horizontal Victor wheels, to develop 400 horse power. These wheels displace an overshot wheel 38 feet diameter, 14 feet face. A number of these wheels are going into some of the best mills in New England, and there is no wheel made that is better adapted than the Victor for a horizontal wheel and for high heads.

* * The American Electric Manufacturing Company is not only meeting with success in the large sales of its apparatus and the extension of its business in the United States, but is rapidly extending its business into the different parts of Europe. The company have recently appointed Mr. Chas. R. Heep, a brother of Major David Porter Heep, of the Corps of Engineers of the United States Army, and Engineer Secretary of the Lighthouse Board, Washington, their resident representative in London. Mr. Heep is an accomplished electrician, having spent many years in electrical work in England, France, and Germany. Mr. Heep has been spending several weeks in New York with the American Company in study of the American apparatus with Prof. Wood, the chief electrician of the company. Mr. Heep sails for Liverpool in about two weeks, accompanied by Mr. W. W. Monroe, manager of the foreign department of the American Company, who will spend a few weeks in Europe in getting the business of the American Company thoroughly established there.

* * The Jarvis Engineering Company, 61 Oliver street, Boston, report the following sales of the Armington & Sims engines: New Haven Electric Co., New Haven, Ct., two 60 horse power; Burlington Gas Light Co., Burlington, Mass., three 60 horse power; Edison Electric Illuminating Co., Brockton, Mass., one 60 horse power; Edison Electric Illuminating Co., Brockton, Mass., one 125 horse power; Nashua Electric Light Co., Nashua, N. H., two 90 horse power; Millbury Electric Light Co., Millbury, Mass., one 35 horse power; Edison United Manufacturing Co., Boston, Mass., one 25 horse power; Dover Electric Light Co., Dover, N. H., one 60 horse power; Traders Electric Light Co., Biddeford, Me., one 90 horse power; Natick Electric Light Co., Natick, Mass., one 60 horse power; Edison Electric Illuminating Co., Great Barrington, Mass., one 80 horse power; Sprague Electric Railway and Motor Co., Richmond, Va., three 100 horse power; Thomson-Houston Co., Boston, Mass, two 125 horse power; Thomson-Houston Co., Southbridge, Mass, one 50 horse power; Thomson-Houston Co., Houlton, Me., one 60 horse power; Newton Electric Light and Power Co., Newtonville, Mass., two 60 horse power; Woonsocket Electric Machine and Power Co., Woonsocket, R. I., one 125 horse power.

* * American electrical supply houses are building up a large trade in Australia. A company, it is said, has been organized with a capital of $500,000 to control the business.

* * The opening of the Montmartre central station will very shortly be followed by a second in the neighborhood of the Pantheon, where a 2,000 light plant is now being erected by the Societe d'Oerlikon. M. Philippart has applied for the authorization of a scheme for lighting all the public buildings in Paris by means of accumulators to be charged from a central station. A similar scheme (and one we should say with as little chance of success) has been set on foot by the Societe pour la Transmission Electrique de la Force, which proposes to light all the theaters in Paris from a single station. The new Opera Comique will be lit by the Edison Company.

* * Dr. Frölich, writing in the *Electrotechnische Zeitschrift*, gives some measurements upon the increase in the impedance of the armature of a Siemens D_2 machine with increasing velocity of rotation. The armature resistance measured 0.3 ohm. When mounted in a wooden frame, and run at 1,100 revolutions, the impedance was 0.911 ohm; while, when in position in the machine, the impedance amounted to no less then 3.62 ohms, the difference being, of course, due to the increased magnetization of the core. Dr. Frölich makes the remark that the coefficient at a given velocity is independent of the position of the brushes, and also of the magnetic intensity of the armature field [current in armature]. This, however, merely shows that the machine was working on the horizontal part of the characteristic. He adds that in the machine used as a motor there is some variation which requires further investigation—a conclusion at which several other investigators have arrived. The chief discrepancy is undoubtedly due to the fact, pointed out by Mr. Mordey, of the different relations of the Foucault currents in the two cases; but this does not seem to cover the whole of the ground.

Bell's Patent Sustained Again.

Judge Wallace, in the United States Circuit Court, last week, handed down a decision in the case of the American Bell Telephone Company, against the Globe Telephone Company, to restrain the defendant from infringing on the patent granted to Alexander Graham Bell on March 7, 1876. Judge Wallace granted the permanent injunction asked for. He says:

The Massachusetts courts held that Bell was the discoverer of the new act of transmitting speech by electricity, and in view of all the facts produced there is no reason why a permanent injunction should not be granted.

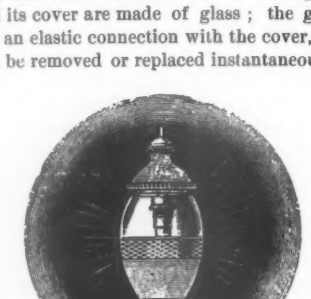
In the answer to the complaint, the defendant averred that it owned the patents of one A. Meucci, who it claimed was the first inventor of the telephone. Meucci is an Italian. He claims that in 1849 or 1850, while at work in a machine shop at Havana, he discovered the manner of transmitting the tones of the voice by electricity. He came to this country, lived on Staten Island, and for twenty-four years, he says, he has had in use in his house his telephone. In 1876 he endeavored to introduce his invention, but, by reason of poverty, he was unable to do so. He published an advertisement of his discovery in *Eco d'Italia*, and endeavored to secure assistance. Some time after this L. Beckwith came from England, where he had secured the right to use and patent in this country the English Bassano-Slater telephone. Beckwith became acquainted with Meucci, and after he became the general manager of the Globe Telephone Company, Meucci was made the electrician, and they started to make an instrument from the Meucci invention and the Bassano-Slater instrument. The new instruments were put up in the office in the Mills building, and in September, 1885, the company issued a circular offering to supply telephone service. Beckwith organized a company in Elizabeth and called it the Meucci Telephone Company. For some reason the Globe Company did not sign a contract with the new company, although such a contract was proposed by Beckwith. The Globe Company and all connected with it are now prohibited, according to the decision, from using either the Meucci or Bassano Slater telephone.

The Toads Fooled.

Some sharp observer in Westfield has discovered that the electric lights recently placed on the more retired streets are demoralizing to the toads. It is asserted that these useful batracians, attracted by the brilliant light when the streets are quiet, gather by dozens under it and hold high revels. The greatly enlarged shadows of countless insects fluttering around the light fall upon the ground, and the innocent toads, thinking them to be real, hop about in all directions to catch them, making it seem as though they were going through a merry cotillon.

Lea's Patent Globe.

Messrs. Fowler, Lancaster & Co., of Birmingham, are manufacturing a new globe for enclosing incandescent electric lamps. The following are some of its special features, says our London namesake:—Both the globe and its cover are made of glass; the globe has an elastic connection with the cover, and can be removed or replaced instantaneously;



New Incandescent Globe.

neither the globe nor the cover has any metallic rim to obstruct the light; the globe is designed so that the maximum amount of light is obtained without the incandescent filament being directly visible; the globe is dust-proof, thereby preventing the lamp from becoming obscured by dust, and avoiding the risk of breaking the lamp in cleaning; the flexible cord is held firmly by an insulating material which relieves the electrical connection of the weight of the globe; the globe can be even roughly handled in cleaning without danger of damaging either the lamp or fittings, and it can be fitted either with the usual socket or loop lamp holders, or with any special form.

Researches on the Electrical Behavior of Mica as an Insulating Medium in Condensers.

From experiments with a mica condenser, in which the author determined the relation of the quantity of electricity discharged to the amount undischarged from the previous charge, the duration and strength of which could be varied, he concluded that mica is unsuitable for use in standard condensers. Some experiments on the resistance of mica would appear to lead to the conclusion that it conducts like an electrolyte.

The Gas-Meter's Infallibility.

An action is now pending which promises to be to the gas companies what the great Dobbs case was to the water companies, says the *Pall Mall Gazette*. The facts are shortly these: A certain customer of one of the great metropolitan gas companies complained not long ago that his gas bill had suddenly jumped from about £6 a quarter to nearly double, but the company denied any mistake on their part, while admitting that the meter might have recorded inaccurately the quantity consumed. But the Government inspector, after testing the meter, certified it to be perfectly correct in its working. Now the customer refuses to pay the increased rate and is to be sued for it, the company submitting to be bound by the decision of the courts. We understand that conclusive evidences will be adduced to show that the actual consumption of gas has not been more than usual, and that there has been no leak on the customer's premises, or any other cause to justify the company's increased charge. The question for decision will be, Is the record of the gas meter as proof of a company's claim legally paramount over all other evidence? The point is an important one, and the case will be watched with interest, for it is curious how often our gas meters go wrong in one direction. They never seem to err in favor of the consumer.

Valuable Tables for Electric Companies.

The Bridgeport Brass Company, Bridgeport, Conn., has recently issued a valuable table in convenient form, giving first the diameter of wire in thousandths of an inch for B. & S. and the English gauges, resistance per mile of bare wire, the weight per mile of insulated wire, and the weight of insulated wire between poles for any number of poles per mile from 20 to 55 inclusive. This company has also issued a similar table, giving the above information for bare wire, and that table includes the data for the new British standard gauge. These two tables will be cheerfully sent to all persons making the request, and are well worth asking for, as they have been prepared by a thoroughly practical man—Mr. H. D. Stanley, of the Bridgeport Company.

Electrical Gatherings.

The seventh reunion of the Old Timers of the United States Military Telegraph Corps will be held at the Hotel Lafayette, Philadelphia, August 17th and 18th.

The National Electric Light Association will meet at the Parker House, Boston, August 9, 10 and 11. The first meeting will be held at noon Tuesday. There promises to be a very large and earnest attendance.

The National Telephone Exchange Association will meet in Pittsburgh September 26. The place of holding the meeting has been left to President Metzgar, who resides in Pittsburgh, and will be hereafter announced.

The next regular meeting of the Electric Club will be held August 18 at Hotel Brighton, Coney Island. An interesting paper will be presented and discussed.

The Electric Light Much the Best.

"A great improvement," remarked the electrician of a large passenger steamer on the New England coast, "was made when the incandescent light was substituted for gasoline. We were constantly on the watch for leaks, which were common, owing to the continued twisting caused by the rolling and pitching of the boat. Countrymen blew the gas out and often died from suffocation. The operating expenses of the electric plant are not in excess of the gasoline apparatus, and the labor and expense saved in cleaning and renewing paint and decorations are considerable."

Cost of Electric Lighting at Bremen.

The *Deutsche Bauztag* says that during the progress of the dredging operations which have been going on day and night in the harbor at Bremen it was decided to replace the lanterns and petroleum flarelights by the electric light, and the contract was given to Messrs. Schückert, of Nürnberg, their tender being the lowest. They were able to reduce the cost of the installation by utilizing the surplus power of two steam boilers at the chief pumping station, and by making use of a 25 horse power reserve engine, already in position, to drive the dynamo. the arrangements being such that the engine could also be made to work a centrifugal pump if required. The engine was driven at 180 revolutions per minute, and the dynamo of the Schückert type constructed to give a current of 16 amperes with 840 revolutions per minute, but 14 or 15 amperes only were utilized in the present case. The light was obtained from 12 arc lamps, each of about 3,000 candle power, enclosed in clear glass globes of 45cm. in diameter, furnished with overhead reflectors a meter in diameter, and attached to masts 20 meters high. The circuit wires were suspended on ordinary telegraph poles six to seven meters high by means of porcelain insulators. The total cost amounts to 3.62d per lamp-hour. The electric light has been found much more satisfactory than the petroleum lights, especially in wet or stormy weather, when the latter, besides being frequently extinguished, consumed about twice as much petroleum as in fine weather. Experiments are now being carried out to determine how many of the petroleum lights would be required to produce an illumination equivalent to that of one of the arc lamps.

* * Col. M. W. Goodyear, of The E. S. Greeley & Co., New York, has just issued for distribution, a new and particularly interesting electrical catalogue.

Results of the Boston Committee's Investigations Abroad.

The joint committee of the Boston City Council, empowered to visit New York and Philadelphia to examine the systems of laying electric wires beneath the surface there adopted, has returned, and Alderman Carroll thus informally gives out some of the results of the investigations :

"They had gone on in the old way in New York for a long time, but at last it was found necessary to appoint a subway committee for the purpose of dealing with the whole question. Remember that the state of things in that city is worse than it is in Boston. They have more telegraph and more telephone companies, consequently more overhead wires than we have We spent a day in looking at the New York system of subways and conduits. From what we saw, I should judge that we are far ahead of the New Yorkers. They use a common wooden conduit in the street; it is practically a square box, with cells called 'ducts,' partitioned off from each other. The structure is of creosoted wood, and is not equal to the cement conduit.

"Next we went to Brooklyn. Mayor Whitney gave us an interview, and we found him strongly of the opinion that the wires must go underground.

"It has been strongly urged," Alderman Carroll went on, "and by those who have technical knowledge of electricity, that it is impossible to carry telephone and telegraph wires in close proximity to wires conveying a current for lighting purposes. This contention was made in New York, but I am satisfied, and the committee are satisfied, that the telegraph and telephone companies are prepared to resist to the utmost, by every kind of objection, all efforts to make them lay their wires underground. And they will do this just as long as municipalities permit them to have all the say in the matter. Their resistance is due to the fact that it costs more, as initial outlay, to lay wires under ground than it does to carry them overhead. But I have no hesitation in saying that it is cheaper for the companies, in the end, to go underground with the wires. It saves them loss by wear and tear, by liability to damage and to injury by fire. They would save money by adopting the underground plan.

"Our experience in Philadelphia throws not a little light on this very question of practicability. We were taken into the cellar of the New City Hall, now in course of erection, and there shown a subway which is recommended to the city for adoption. It has a cemented or asphalted floor, bricked like a square tunnel, eight feet high and about four feet wide. The idea is to run that through the center of the city—some of the streets are four or five miles long—and have trunk lines carried into the smaller streets. The work could be done for $1,500,000 or $2,000,000. The companies using the conduit would pay an amount greater than the interest on the investment, so that in a few years the thing would pay the original cost."

We are not aware that there are any creosoted wood conduits being used in New York city as yet, and know of very little of any other kind. The conduits in use in New York, Philadelphia, Boston, etc., are in a great measure experimental, and the question of their feasibility has not been determined to the satisfaction of the companies called upon to use them.

The Electric Seismometer.

We present two views of the electric seismometer invented by Dr. Otto A. Moses, of this city, and manufactured by the The E. S. Greeley & Company. This very delicate instrument was described in detail in a former issue in the interesting paper read by Dr. Moses before the Electric Club. The views presented in this issue of the REVIEW will give our readers an excellent idea of the appearance of the seismometer.

Electric Scarecrows.

A motor adapted to drive dynamos for incandescent lighting. A weight is used, which is to be wound up every morning, by the head of the family, as a new form of exercise.

A telephone invented by Archimedes. He died some years ago.

An itinerant medical electrician who gives shocks, and knows the difference between an ohm and a watt.

A primary battery which produces light cheaper than gas.

A telephone girl who talks loud.

A Successful Motor.

THE FISHER ELECTRIC RAILWAY SYSTEM OF DETROIT.

There are many things which yield fame to the City of the Straits, and among others is the fact that it is becoming a depot of supply for electric railways. The Fisher system has found general favor. It is the invention of Frank E. Fisher, manager of the Detroit Electrical Works. The motor is now in use on the Highland Park road in Detroit, is being put in on the Grosse Pointe road, and is also being put in operation on a road in Pittsburgh, and now there is an important addition to the list of successes. In June Mr. Fisher learned that a company purposed building an eight-mile road from San Jose to Santa Clara, Cal. The cable system was most talked of. The young inventor immediately started for the Pacific slope, and laid his system before the company. Samuel A. Bishop, the president of the company, and E. A. Rich, vice-president, both extremely wealthy men, were much pleased with the system, and informed the inventor that they would consider the matter and let him know, and he came home. Last week Mr. Fisher received word that his motor had been selected, and in September he will go to California to superintend the building of the road. He naturally is elated over the success of his invention. The road in question is to be eight miles long, an underground conduit between San Jose and Santa Clara, the combined population of which towns is about 50,000. The total cost of the road will be $300,000. Eight motors are to be used, each drawing two cars, and the dynamo capacity will be twelve motors. If the San Jose road proves a success—and, judging by the Highland Park road, it cannot prove otherwise—the Fisher system will be given a trial in San Francisco, capitalists there having announced that if it suits them they will have an underground road in Frisco.

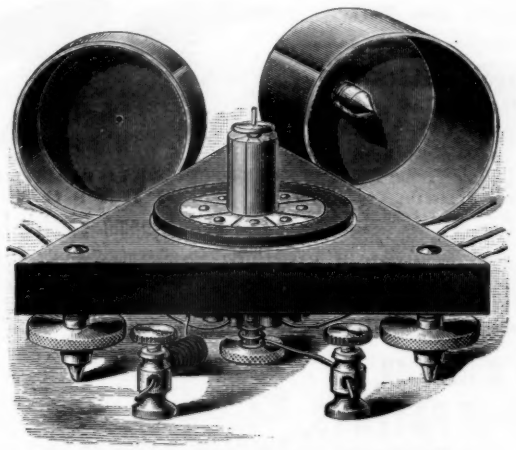


FIG. 1.—ELECTRIC SEISMOMETER.—INTERIOR VIEW.

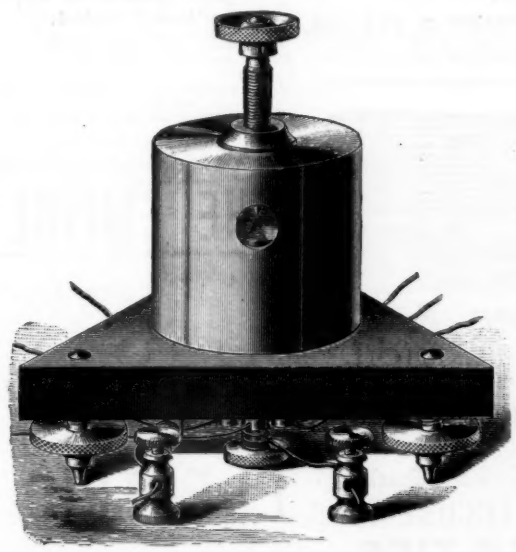


FIG. 2.—SEISMOMETER COMPLETE.

—— The New York Central Railroad Company is said to be about to extend its experiments in electric lighting by means of storage batteries, and will illuminate the stations and station grounds along the line of the road.

—— The factory of the well-known Pittsburgh Carbon Company has been purchased by a company organized in Pittsburgh under the name of the Faraday Carbon Company. These works have now a capacity of over a million carbons per month.

—— Mr. D. W. Baker, the well-known manufacturer of platinum, returned this week from an extended tour in Europe and the enjoyment of well earned rest and recreation. His electrical friends were rejoiced to see him again fully restored to health.

—— The Lima (Ohio) Electric Railway, the first and only one in Ohio, was opened by a ride over the line given to the city officials, prominent citizens, and representatives of the press, by B. C. Faurot, the owner. The road is of the overhead wire system, and works well.

—— The New Orleans Gas Light Company has filed a suit in the Civil District Court to compel the city to annul its contract with the Louisiana Electric Light and Power Company.

—— The Hartford Electric Light Company has declared a semi-annual dividend of 3 per cent., payable on demand. This company is well managed. The Thomson-Houston system is used.

—— A corporation, styling itself the Hauss Electric Lighting and Power Company, applied to the Board of Public Affairs, of Cincinnati, for permission to place its lines in the streets for the purpose of furnishing light and power to consumers. The lines are to be laid in conduits below the roadways. If the Board objects to this plan, then permission is asked to build pole lines. Offers were made to furnish the city with light and to sell the plant after twenty-five years. It was referred to the Committee on Light.

ELECTRIC LIGHT NEWS

—— There will be two or three alternating systems exhibited at the National Electric Light Association, in Boston, August 9, 10, and 11.

——A French engineer soaks rags in petroleum and ignites them by electricity at fixed intervals when the men are out of the mines, to burn the fire-damp.

—— The REVIEW invites all workers with the electric light to note the electrical books furnished by this journal, a list of which we publish on another page.

—— The Mather Electric Company, of Manchester, have just received an order for a 1,600 light plant for the largest hotel on the Pacific coast, at San Diego, California. Mr. J. H. Reid, of Chicago, closed the contract.

—— The Schuyler Electric Company, of Hartford, are considering moving their works to New Britain. The Kempshall Company's property on Chestnut street has been looked over, though nothing definite about a location has been decided.

—— Since the going into effect of the new law in Massachusetts, three gas companies, respectively of Brookline, Clinton and Chelsea, have applied to the gas commissioners for authority to furnish electric light. One hearing has been held in the Chelsea case, which remains unfinished. The other cases will be considered later.

—— A very tasty notice is sent out by Messrs. Armington & Sims, Providence, in which is stated the following: "We are pleased to inform you that we have purchased the Monohassett Mill property, and as soon as we can transfer our plant, our facilities will be so largely increased that we hope to be able to meet the demand for our engines. This we have been unable to do in our present quarters."

—— The large building of the Mather Electric Light Company, at South Manchester, is about finished. It is large enough to accommodate six or seven hundred workmen. Four hundred are to be employed as soon as the new factory is started. One hundred new dwelling-houses are wanted at South Manchester to accommodate the workmen who are to be employed in making the dynamos and fixtures for electric lights. Mr. Mather has invented or applied an engine to be attached directly to the dynamo, dispensing entirely with leather belting. The building is complete in every respect, and is most creditable to the energetic general manager of the company, Mr. N. T. Pulsifer.

—— A Cairo correspondent feels very badly for the poor skipper who has to go through the Suez Canal, which is now lighted by electricty. Going southward, in the full glare of the Egyptian desert, facing the sun, unfits him much at nightfall. If at that time he exchanges the blazing sun for the dazzling electric light, by the time the vessel gets out of the Suez Canal the dazed and jaded skipper cannot be in a fit condition to take his ship the next night through reefs which abound in the Gulf of Suez, and the endeavour to avoid which calls for his utmost vigilance, care and skill. The writer goes on to say that after a few outward-bound ships have knocked their bottoms out in that part of the world, the underwriters will awake to the fact that the electric light in the canal is to a great extent to blame for these catastrophes. Homeward-bound commanders, after running the gauntlet of the Red Sea shoals and the risks of the Gulf of Suez, find the Suez Canal a sufficiently tiresome business by day: but to do it by night in addition, by the aid of the electric light, means that by the time they reach Port Said every man on board will have been worked to death. We fear the correspondent is prejudiced.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JULY 19, 1887.

366,654 Electric bell coupler for steam railroads; Joseph M. Duby and Joseph L. Edmester, Chelsea, Mass.

366,660 Electric boot-blacking apparatus; Henry R. Gardner, Boston, Mass.

366,673 Device for holding incandescent lamp filaments while the same are being flashed; Hermann Lemp and Merle J. Wightman, Hartford, Ct., assignors to the Schuyler Electric Manufacturing Company, of Connecticut.

366,695 Quadruplex telegraphy; Gerritt Smith Astoria, N. Y., assignor to the Western Union Telegraph Company, of New York.

366,898 Insulating compound; James Tatham, Philadelphia, Pa.

366,933 Electric arc light; Stefan Doubrava, Bohemia, Austria-Hungary.

366,941 Dynamo-electric machine; James W Eaton, New York, N. Y.

366,970 Telegraph instrument; William A. Melbourne, Swanwick, assignor of one-half to Simon K. Burton, Belleville, Ill.

367,002 Electric lamp; Charles A. Homans, Winchester, Mass., assignor, by direct and mesne assignments, to Lydia K. Homans, same place, Oscar F. Gunz, Rutherford, N. J., and Isidore L. Baeza, New York, N. Y.

367,003 Ear-piece for telephones; 367,004, Ear piece for telephones; George A. Huewe, Cincinnati, Ohio, assignor to Thomas C. Bradford, same place.

BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court 17 Beekman St., New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed, to succeed N. S. Keith, of the patent agency of the *Electrical World*, and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend." —*New York Observer*.

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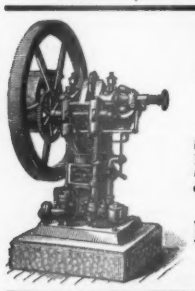

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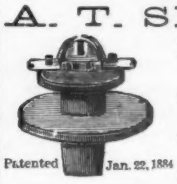

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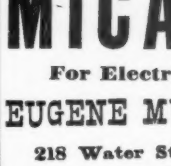

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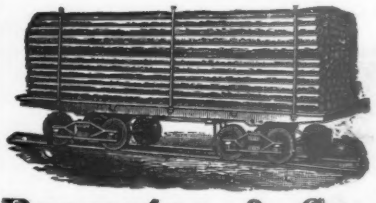

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J. H. Reid, General Manager of the Mather Electric Light Co., Chicago.
Wm. H. Purdey, Comm. of Public Works, Chicago.
John Mab, Chief Engin'r of Board of Trade, Chic.
C. J. Meimes, Gen'l Sup't Thomson-Houston Light, Omaha, Neb.
J. A. Corbey, St. Joe Electric Light and Power Co., St. Joe, Mo.
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